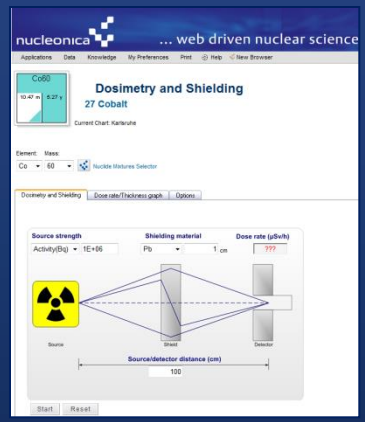
Nucleonica: Core Applications and Case Studies
BfS training course with “Hands on” exercises, 27-28 November 2013, Köpenpicker Allee 120-130, 10318 Berlin

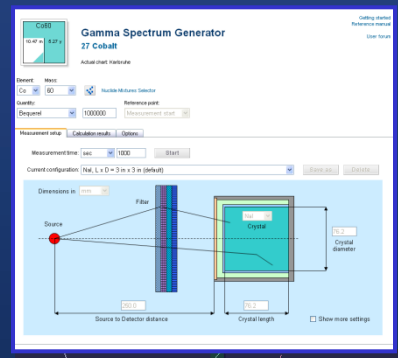
Training Course / Nucleonica Overview

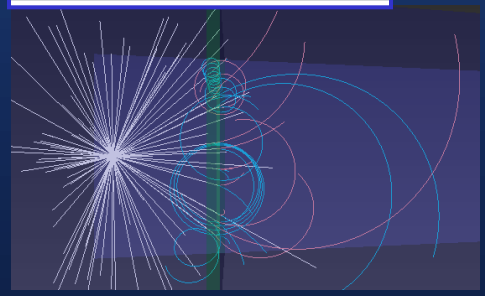
Dr. Joseph Magill,
Nucleonica GmbH,
Karlsruhe

Nucleonica: Web-based Software Tools for Simulation and Analysis

- Nuclear Data Resources in Nucleonica
- Nuclear Science Applications & Tools
  - Decay Engine
  - Dosimetry & Shielding
  - Virtual Cloud Chamber
  - Gamma Spectrum Generator
  - webKORIGEN
  - e-Ship
- Education & Training with Nucleonica
  - Nucleonica Mobile
  - Karlsruhe Nuclide Chart
- Knowledge Management with Nucleonica







These lectures are available online:
http://www.nucleonica.com/wiki/index.php?title=Training_Course_Proceedings#Nov._2013_BfS.2C_Berlin

Links to the presentations:

- go to wiki on main Nucleonica page

- click on Training Courses

- at bottom of page click on Training Course Proceedings

Previous Training Courses [edit]

Nov. 2013 BfS, Berlin [edit]

Nucleonica: Core Applications and Case Studies, 27-28 November, BfS Berlin, 2013.

This 1-day training course took place at the offices of the Federal Office for Radiation Protection (Bundesamt für Strahlenschutz BfS) in Berlin, during the 27-28 November 2013. This was an intermediate level training course which focused mainly on the Nucleonica core applications with emphasis on Case Studies. A detailed description of nuclear data with particular reference to the various Nucleonica nuclear databases was given. Core applications were demonstrated through the use of Nucleonica applications such as the Mass Activity Converter, Nulcide Mixtures, Decay Engine++, and Dosimetry and Shielding++. Two new nuclear security related case studies were given on the identification of suspected nuclear and radioactive materials.

In total, 12 persons took part in the course from the various BfS locatins in Germany. Speakers included Drs. Z. Soti from the JRC/ITU in addition to Dr. J. Magill and Mr. R. Dreher from the Nucleonica team.

Agenda November 2013

Meet the Trainers for this course

Links to the presentations (to be updated before the course):

Nucleonica Overview (J. Magill)

Mass Activity Converter (R. Dreher)

Nuclide Mixtures (R. Dreher)

Decay Engine++ (J. Magill)

Gamma Dosimetry & Shielding++ (J. Magill)

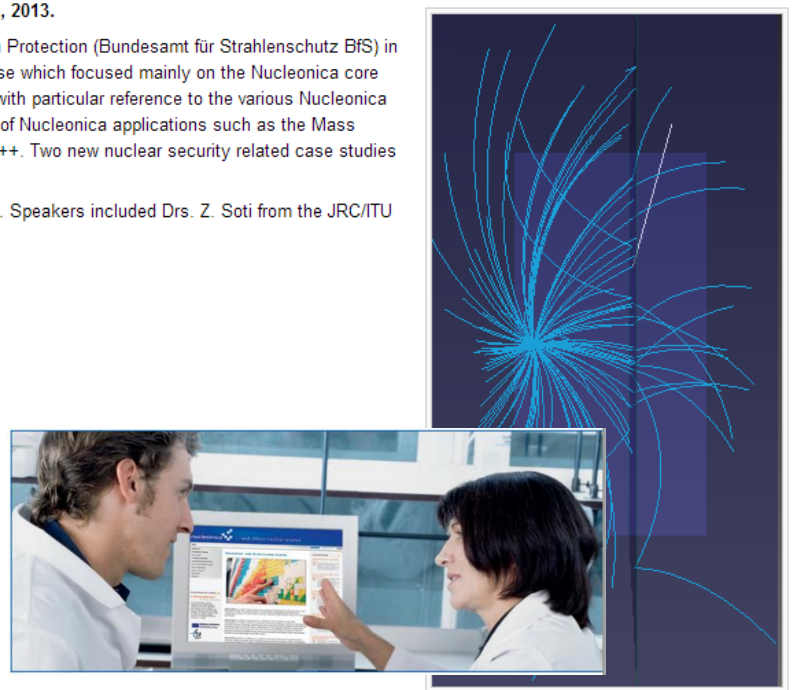
Nuclear Data: from the Karlsruhe Nuclide Chart to Nucleonica (Z. Sóti)

Case Study I

Case Study II

Nucleonica Tips & Tricks (J. Magill)

Nucleonica brochure



Stopping of 500 keV beta particels in 1 mm tissue.

Course Folders…

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Nucleonica: Core Applications and Case Studies

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27. Nov. – Core Applications and Tools

Index

13:30	**Training Course / Nucleonica Overview** J. Magill (Nucleonica)		1
14:15	**Mass Activity Converter** R. Dreher	Exercises	2
15:10 – Coffee			
15:30	**Nuclide Mixtures** R. Dreher	Exercises	3
16:30	**Decay Engine** J. Magill	Exercises	4
17:30 – End of session			

28. Nov. – Core Applications and Case Studies

9:00	**Gamma Dosimetry & Shielding** J. Magill	Exercises	5
	Nuclear Data: from the Karlsruhe Nuclide Chart to Nucleonica, Z. Soti (ITU)	Exercises	6
10:30 – Coffee			
10:50	**Case Study I** J. Magill		7
11:40	**Case Study II** Z. Soti		8
12:30	**Nucleonica Tips & Tricks** J. Magill		9
12:50	Feedback/Questionnaire, Certificate		
13:00 – End of Training Course			

1 2 3 4 5 6 7 8 9 10 11 12

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Nucleonica: Core Applications and Case Studies

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How can Nucleonica help you?

- Nucleonica provides you with user friendly access to the latest reference data from internationally evaluated nuclear data.
- A unique feature is the wide range of validated web-based nuclear science applications for decay calculations, dosimetry & shielding, gamma spectrometry, etc.
- In addition Nucleonica offers a range of introductory and advanced training courses in various areas of nuclear science.

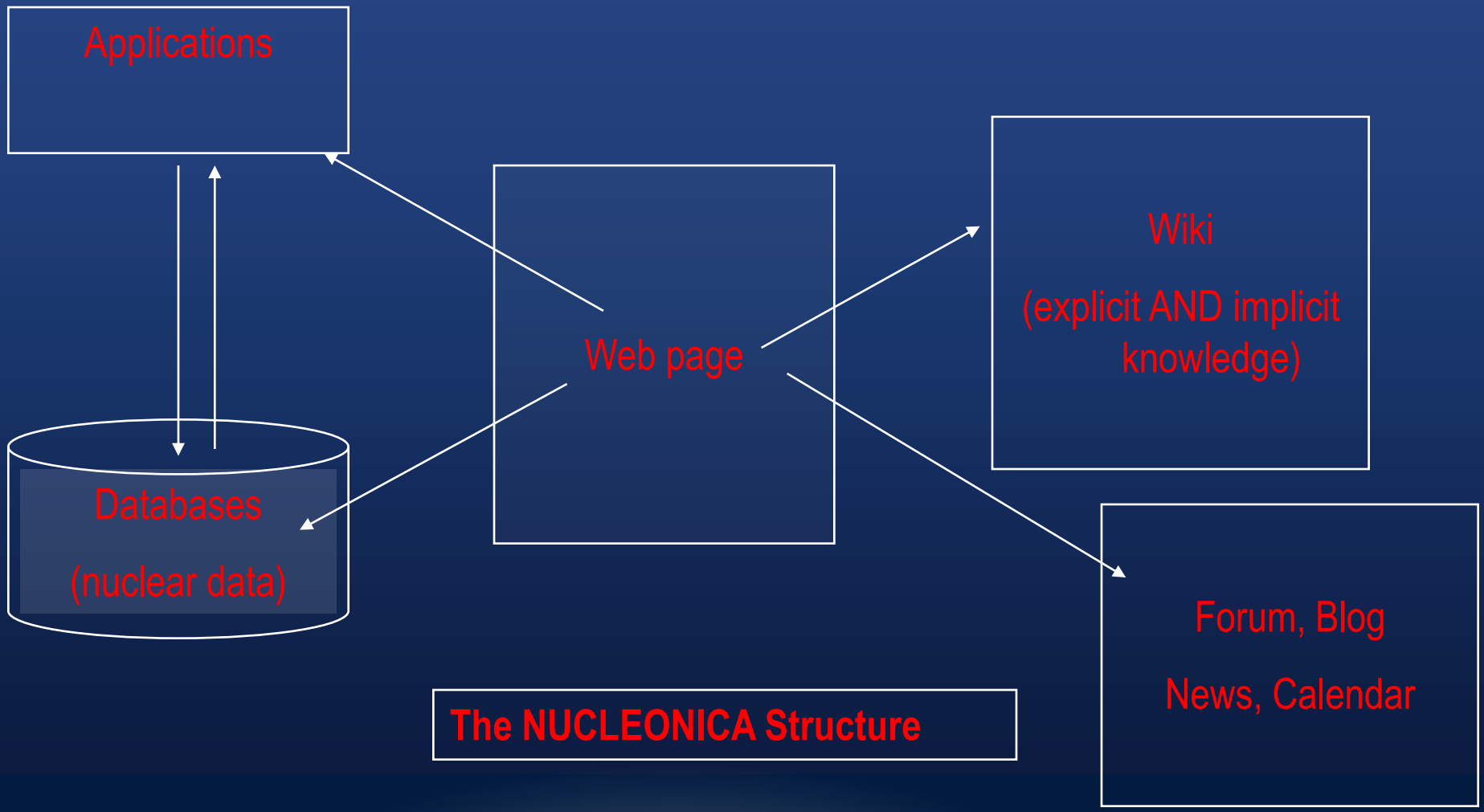
CERN · PAUL SCHERRER INSTITUT PSI · TRIUMF · PRINCETON UNIVERSITY

Bundesamt für Strahlenschutz · JÜLICH FORSCHUNGSZENTRUM · SCK·CEN · WAK · HZB Helmholtz Zentrum Berlin · CEZ GROUP

Nucleonica is already being used by thousands of scientists and students worldwide in over 92 countries. Due to its advanced IT features, user friendly and intuitive environment, the platform has recently been endorsed by the Sustainable Nuclear Energy Technology Platform (www.snetp.eu):

"Nucleonica plays … an important role in making nuclear education more attractive and in building nuclear knowledge for a new generation of engineers and scientists"

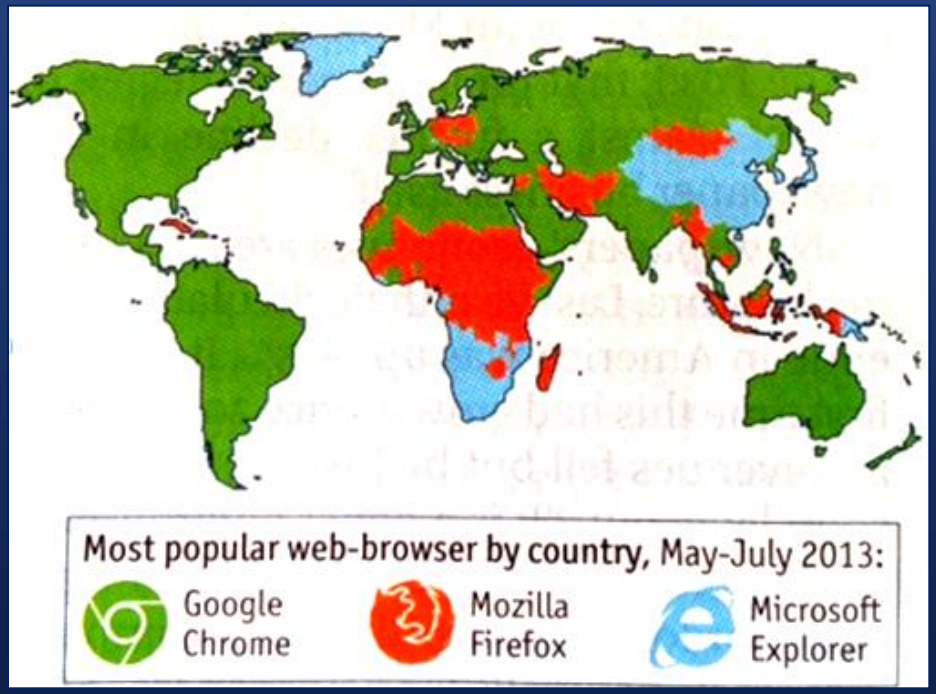
Nucleonica Architecture & Logical Structure…

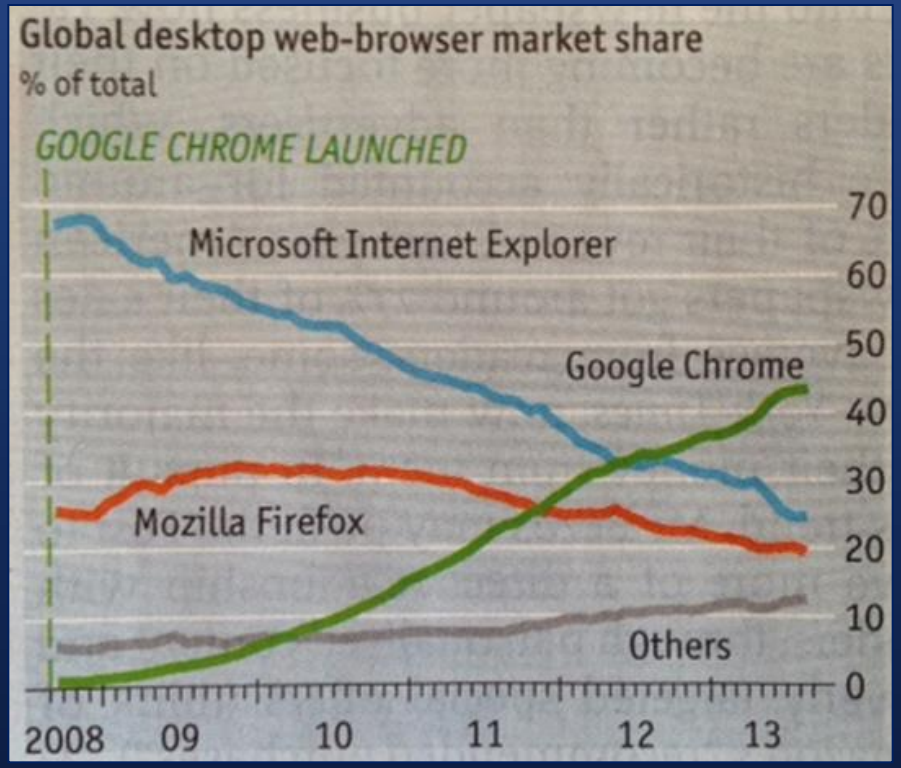


The NUCLEONICA Structure

Which browser?

Nucleonica supports mainly Chrome, Firefox, and IE9, and Safari





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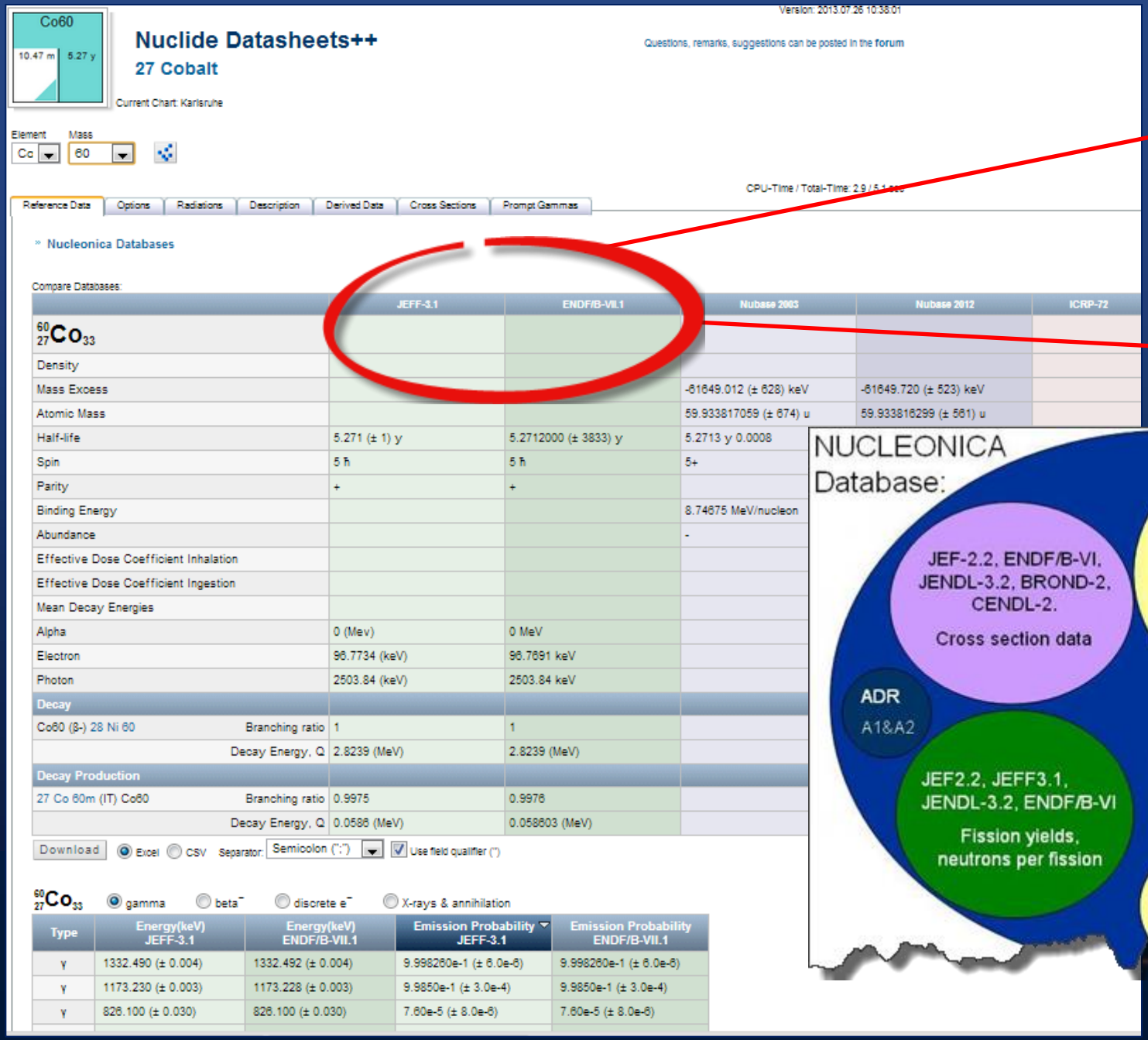
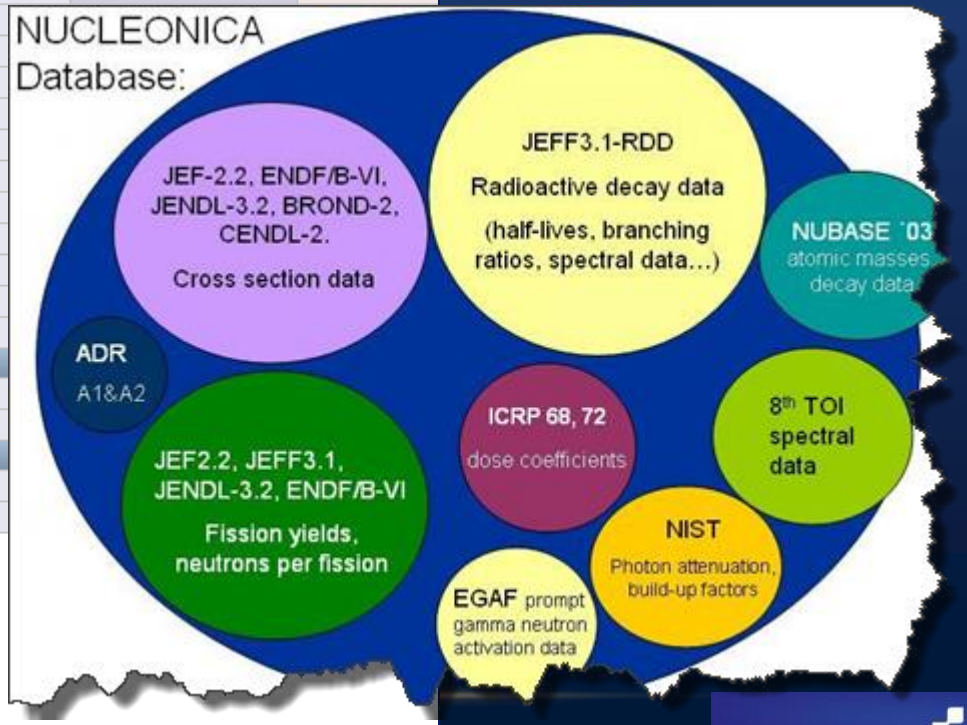
Nuclear Data Resources in Nucleonica: Nuclide Datasheets++



Main Nucleonica database JEFF3.1 contains decay data on 3852 nuclide.

New: ENSDF/B-VII.1



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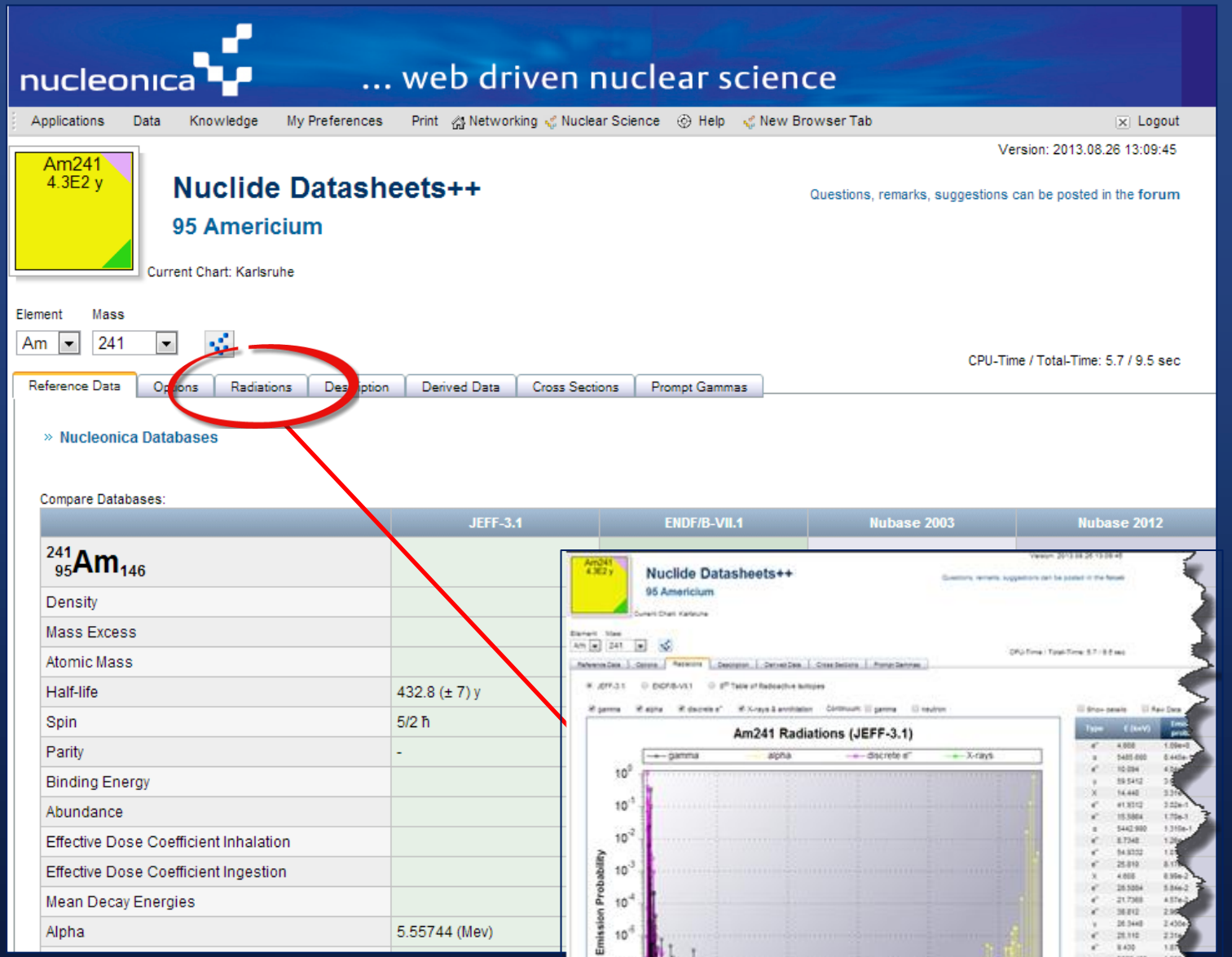
Nuclear Data Resources in Nucleonica:

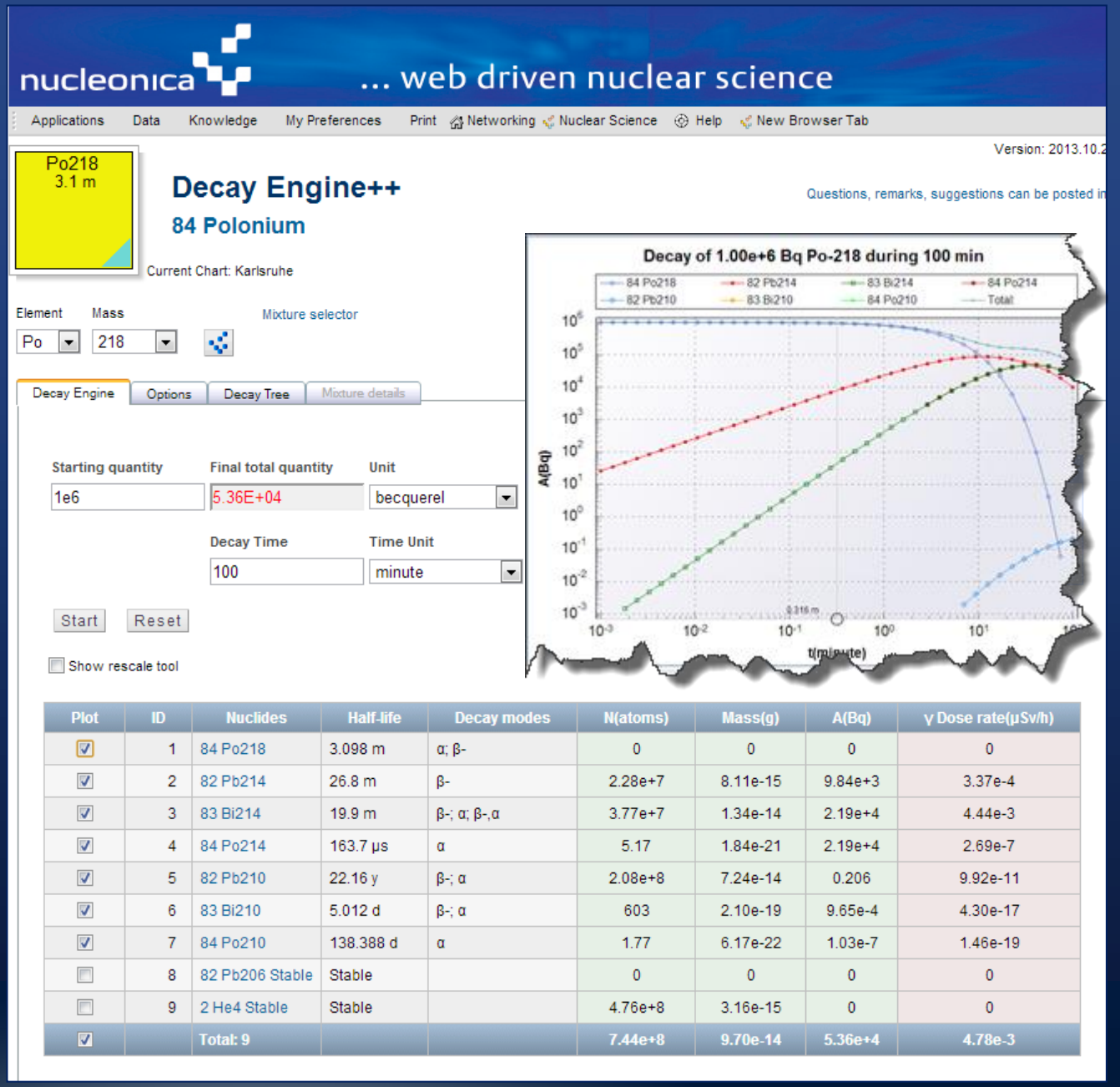
Nuclide Datasheets++:

User friendly access to internationally evaluated nuclear data



Validated Nuclear Science Applications & Tools

Radioactive decay calcluations with Decay Engine++



Plot	ID	Nuclides	Half-life	Decay modes	N(atoms)	Mass(g)	A(Bq)	γ Dose rate(μSv/h)
☑	1	84 Po218	3.098 m	α; β-	0	0	0	0
☑	2	82 Pb214	26.8 m	β-	2.28e+7	8.11e-15	9.84e+3	3.37e-4
☑	3	83 Bi214	19.9 m	β-; α; β-,α	3.77e+7	1.34e-14	2.19e+4	4.44e-3
☑	4	84 Po214	163.7 μs	α	5.17	1.84e-21	2.19e+4	2.69e-7
☑	5	82 Pb210	22.16 y	β-; α	2.08e+8	7.24e-14	0.206	9.92e-11
☑	6	83 Bi210	5.012 d	β-; α	603	2.10e-19	9.65e-4	4.30e-17
☑	7	84 Po210	138.388 d	α	1.77	6.17e-22	1.03e-7	1.46e-19
☐	8	82 Pb206 Stable	Stable		0	0	0	0
☐	9	2 He4 Stable	Stable		4.76e+8	3.16e-15	0	0
☑		Total: 9			7.44e+8	9.70e-14	5.36e+4	4.78e-3

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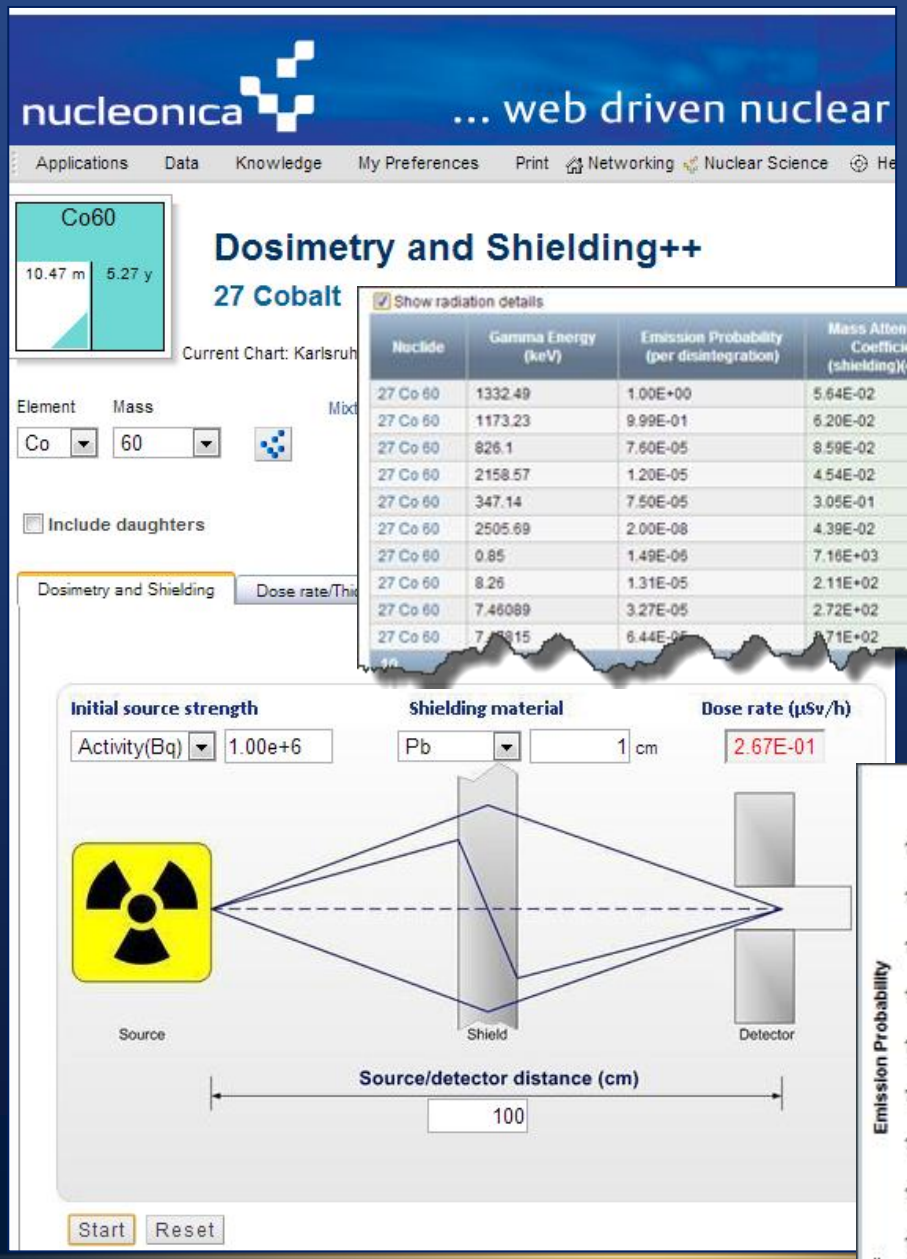
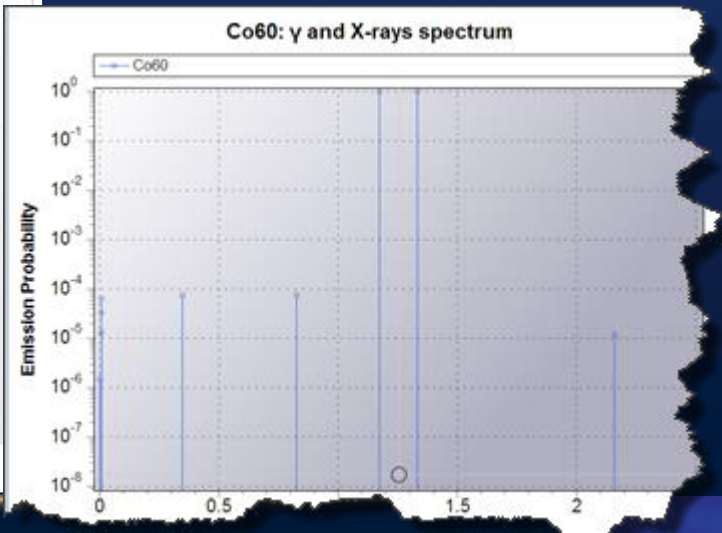
Dosimetry & Shielding++





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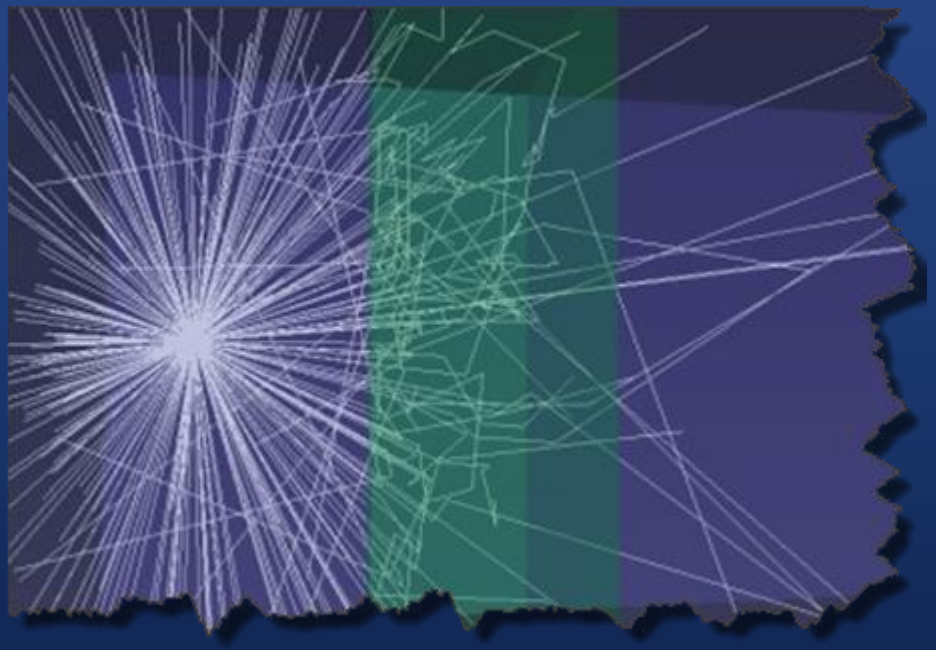
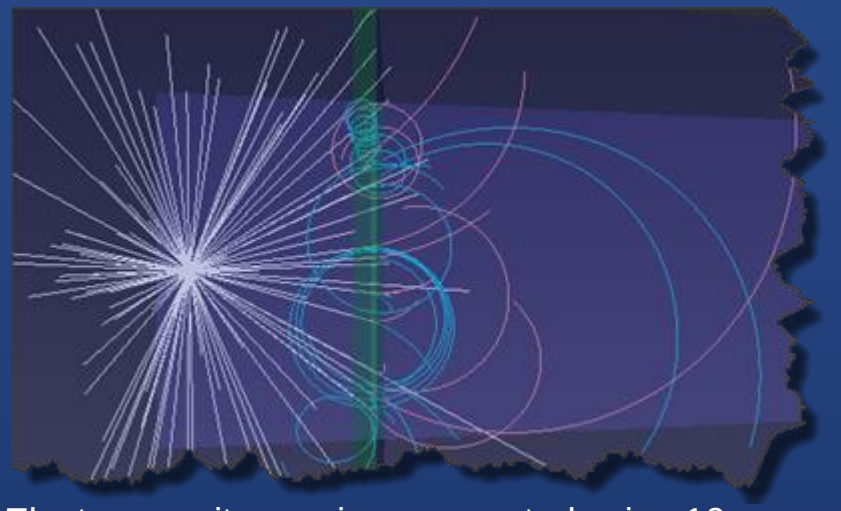
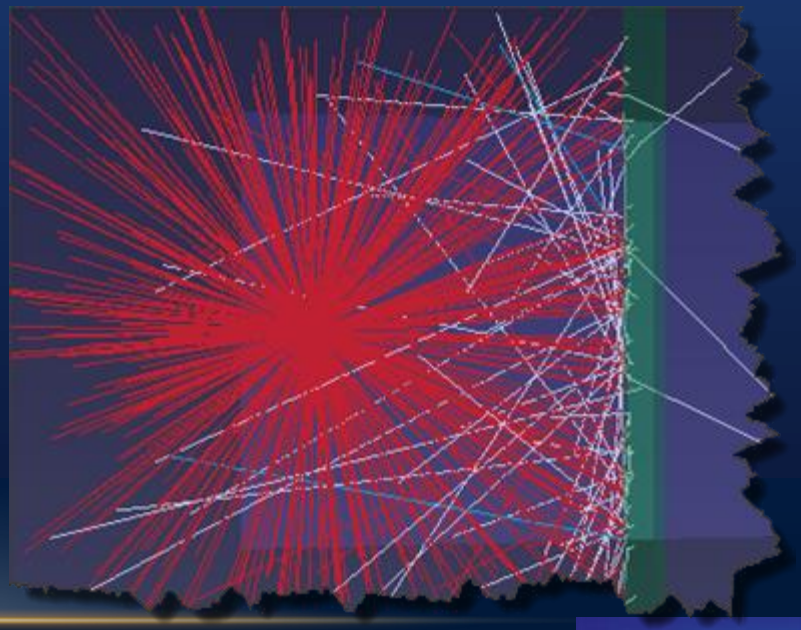
Virtual Cloud Chamber



low energy photons (energy 100 keV) are attenuated with a thick (15 cm) water shield. This combination of low energies and thick shields give rise to multiple scattering of the radiation



Electron-positron pairs are created using 10 MeV photons on lead. By “switching off” energy loss mechanisms, the charged particles are seen to spiral in the applied magnetic field.



The red particles (3 MeV positrons) are blocked by a lead shield (green). When the positrons collide with the shield, they combine with electrons (blue) to create gamma radiation (white). Only a few gamma photons pass through the shield material.

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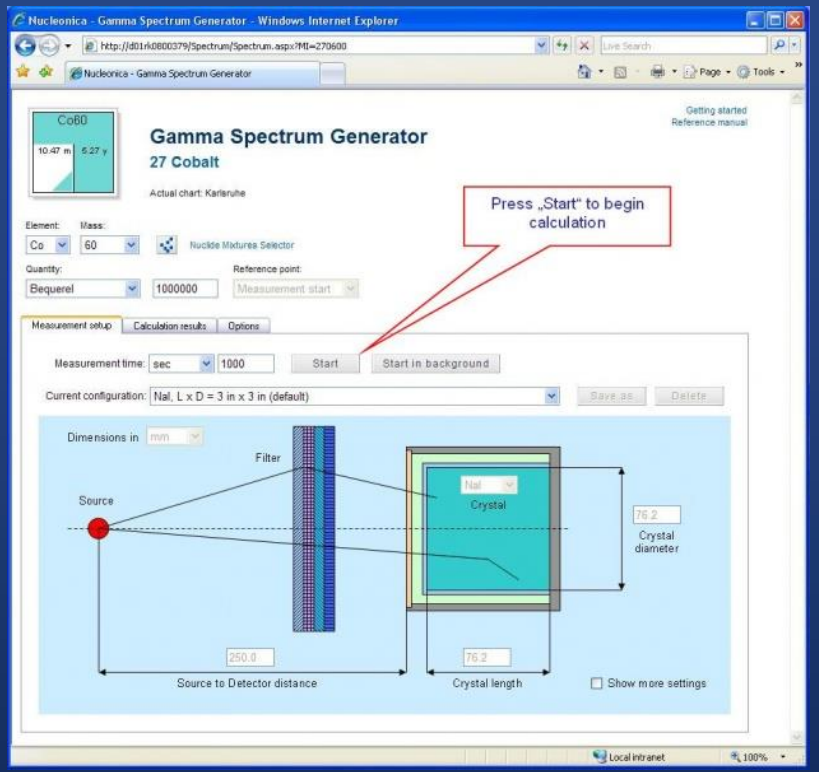
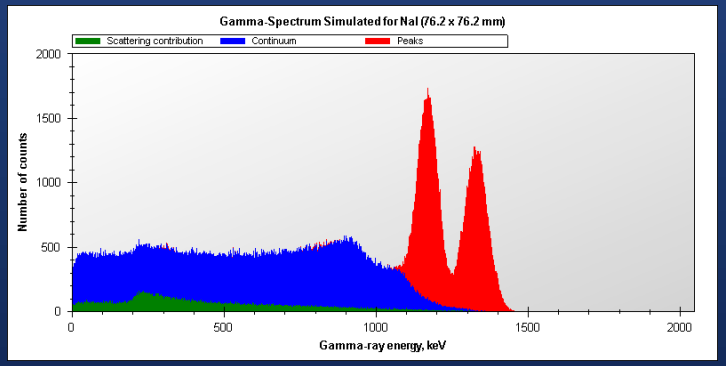
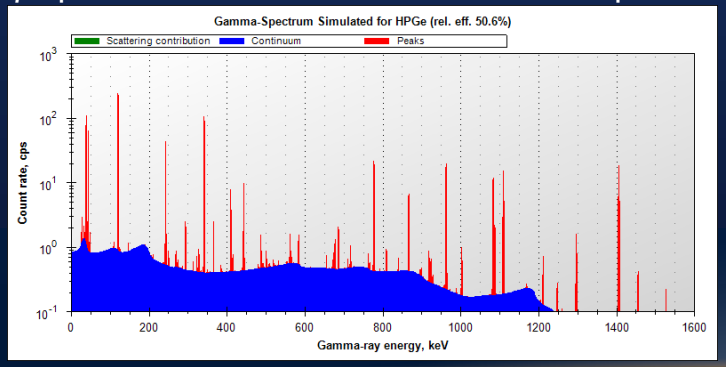
Gamma Spectrum Generator

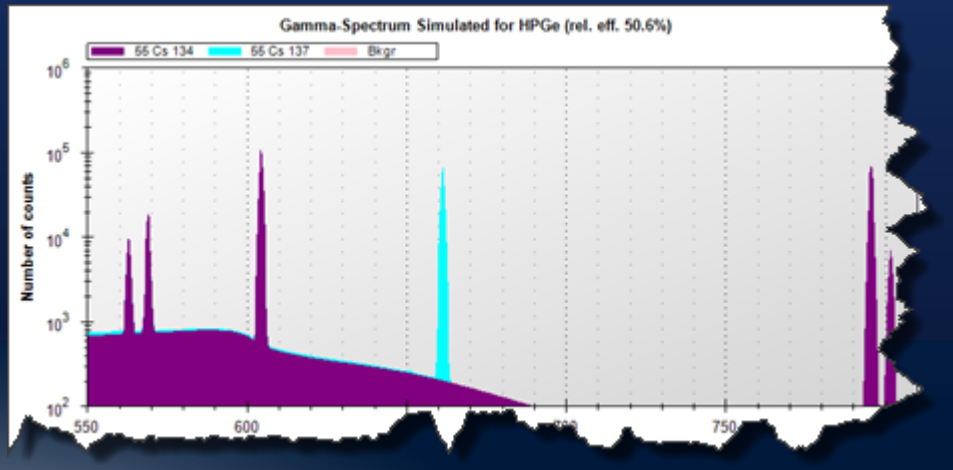


γ-spectrum simulated for ^{60}Co 100 kBq source and NaI (3" × 3") detector:



γ-spectrum simulated for ^{152}Eu 100 kBq source and HPGe detector.





Fukushima: Gamma spectrum of contamination at the Daiichi plant.
Contamination is almost entirely to cesium-137 and cesium -134

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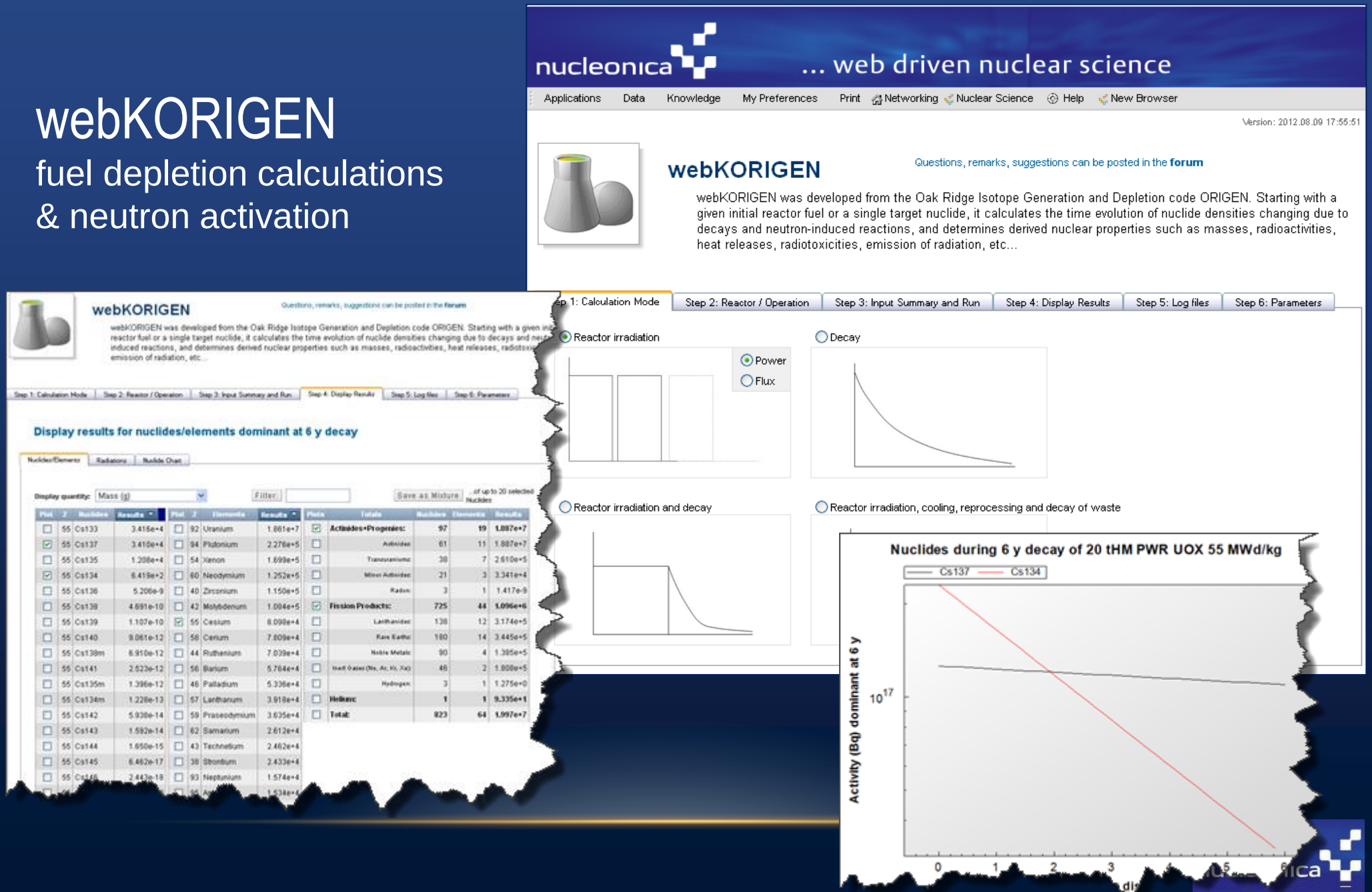
webKORIGEN

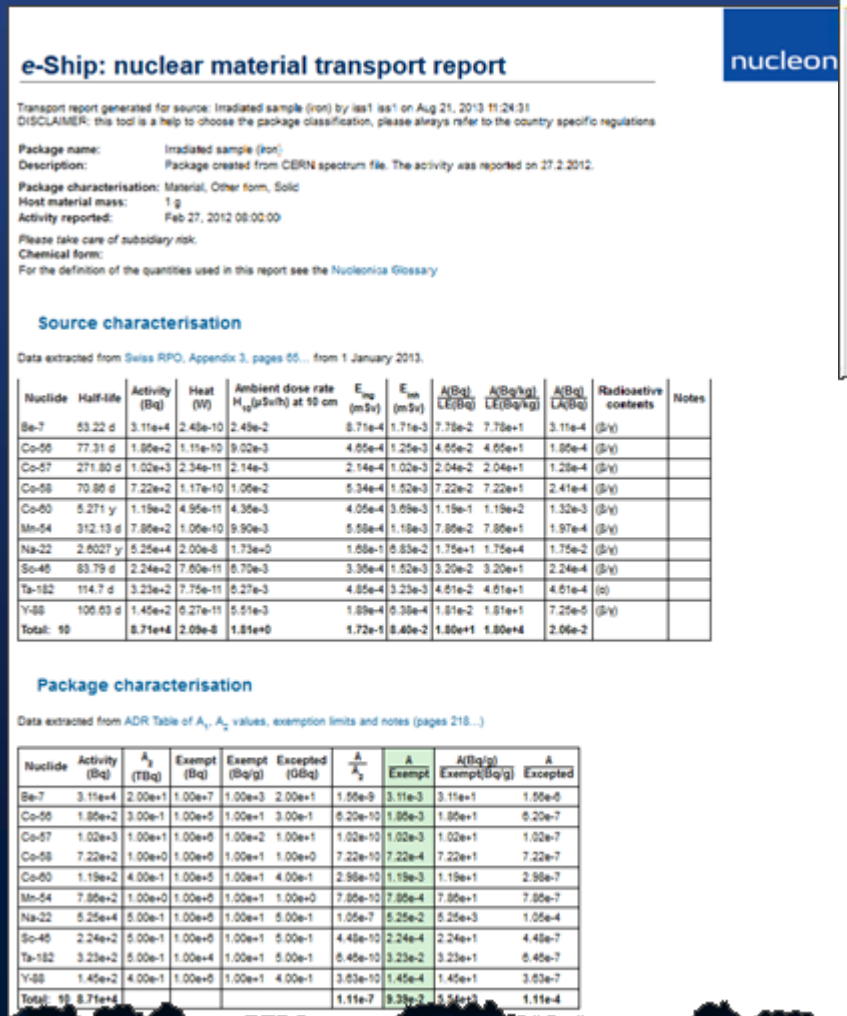
fuel depletion calculations
& neutron activation



Validated Nuclear Science Applications & Tools

e-Ship++:

package classification for radioactive transports



e-Ship: nuclear material transport report

Transport report generated for source: Irradiated sample (iron) by ias1 ias1 on Aug 21, 2013 11:24:31
DISCLAIMER: this tool is a help to choose the package classification, please always refer to the country specific regulations

Package name: Irradiated sample (iron)
Description: Package created from CERN spectrum file. The activity was reported on 27.2.2012.

Package characterisation: Material, Other form, Solid
Host material mass: 1 g
Activity reported: Feb 27, 2012 08:00:00

Please take care of subsidiary risk.
Chemical form:
For the definition of the quantities used in this report see the Nucleonica Glossary

Source characterisation

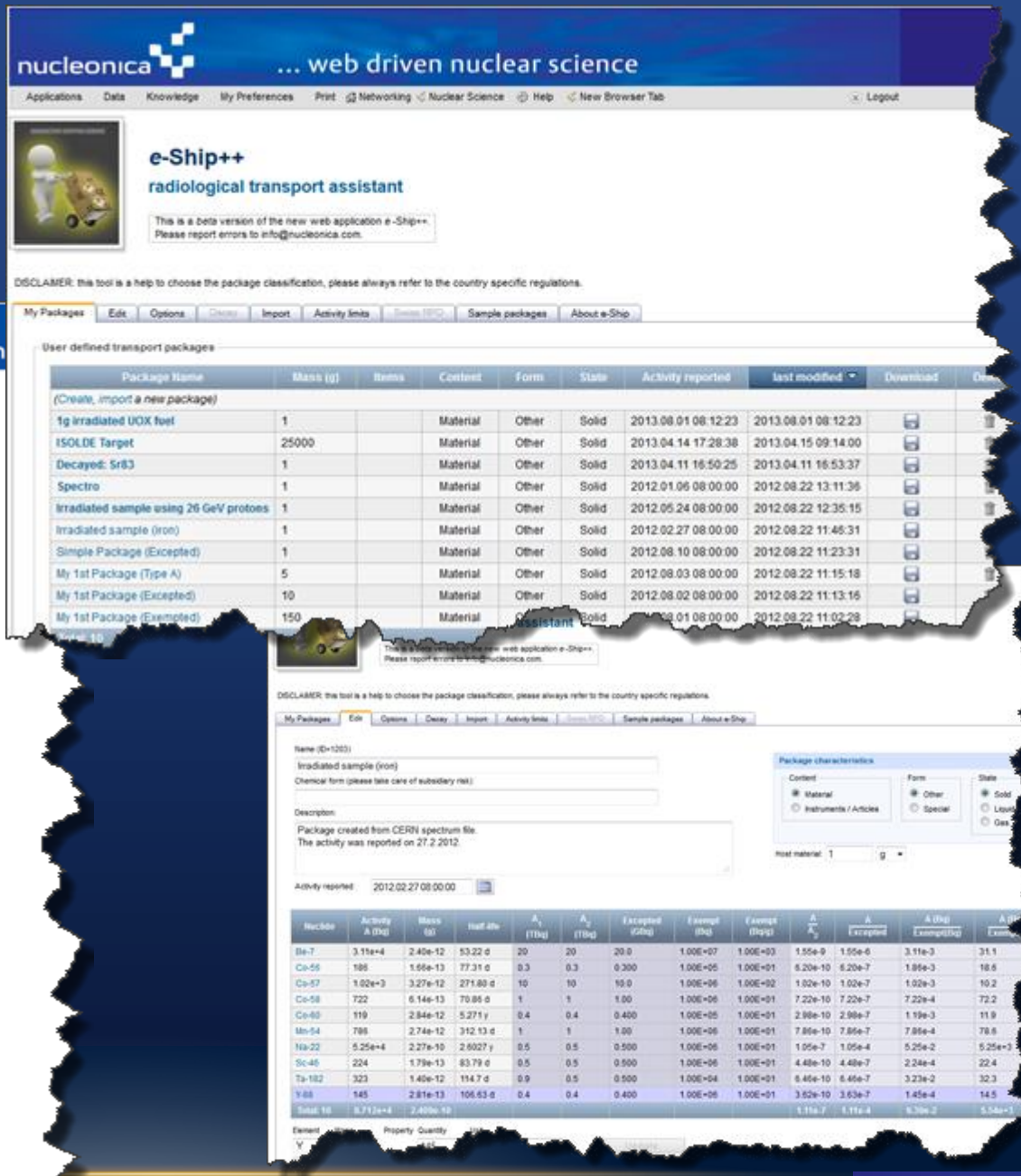
Data extracted from Swiss RPO, Appendix 3, pages 66... from 1 January 2013.

Nuclide	Half-life	Activity (Bq)	Heat (W)	Ambient dose rate H_{10}(μSv/h) at 10 cm	E_{mg} (mSv)	E_{ms} (mSv)	A(Bq) LE(Bq)	A(Bq/kg) LE(Bq/kg)	A(Bq) LA(Bq)	Radioactive contents	Notes
Be-7	53.22 d	3.11e+4	2.48e-10	2.45e-2	8.71e-4	1.71e-3	7.78e-2	7.78e+1	3.11e-4	(β/γ)	
Co-56	77.31 d	1.86e+2	1.11e-10	9.02e-3	4.65e-4	1.25e-3	4.65e-2	4.65e+1	1.86e-4	(β/γ)	
Co-57	271.80 d	1.02e+3	2.34e-11	2.14e-3	2.14e-4	1.02e-3	2.04e-2	2.04e+1	1.28e-4	(β/γ)	
Co-58	70.86 d	7.22e+2	1.17e-10	1.06e-2	5.34e-4	1.52e-3	7.22e-2	7.22e+1	2.41e-4	(β/γ)	
Co-60	5.271 y	1.19e+2	4.95e-11	4.36e-3	4.05e-4	3.69e-3	1.19e-1	1.19e+2	1.32e-3	(β/γ)	
Mn-54	312.13 d	7.86e+2	1.06e-10	9.90e-3	5.58e-4	1.18e-3	7.86e-2	7.86e+1	1.97e-4	(β/γ)	
Na-22	2.6027 y	5.25e+4	2.00e-8	1.73e+0	1.68e-1	6.83e-2	1.75e+1	1.75e+4	1.75e-2	(β/γ)	
Sc-46	83.79 d	2.24e+2	7.60e-11	6.70e-3	3.36e-4	1.52e-3	3.20e-2	3.20e+1	2.24e-4	(β/γ)	
Ta-182	114.7 d	3.23e+2	7.75e-11	6.27e-3	4.85e-4	3.23e-3	4.61e-2	4.61e+1	4.61e-4	(α)	
Y-88	106.63 d	1.45e+2	6.27e-11	5.51e-3	1.89e-4	6.38e-4	1.81e-2	1.81e+1	7.25e-5	(β/γ)	
Total: 10		**8.71e+4**	**2.09e-8**	**1.81e+0**	**1.72e-1**	**8.40e-2**	**1.80e+1**	**1.80e+4**	**2.06e-2**		

Package characterisation

Data extracted from ADR Table of A_1, A_2 values, exemption limits and notes (pages 218...)

Nuclide	Activity (Bq)	A_2 (TBq)	Exempt (Bq)	Exempt (Bq/g)	Excepted (GBq)	$\frac{A}{A_2}$	A Exempt	A(Bq/g) Exempt(Bq/g)	A Excepted
Be-7	3.11e+4	2.00e+1	1.00e+7	1.00e+3	2.00e+1	1.56e-9	3.11e-3	3.11e+1	1.56e-6
Co-56	1.86e+2	3.00e-1	1.00e+5	1.00e+1	3.00e-1	6.20e-10	1.86e-3	1.86e+1	6.20e-7
Co-57	1.02e+3	1.00e+1	1.00e+6	1.00e+2	1.00e+1	1.02e-10	1.02e-3	1.02e+1	1.02e-7
Co-58	7.22e+2	1.00e+0	1.00e+6	1.00e+1	1.00e+0	7.22e-10	7.22e-4	7.22e+1	7.22e-7
Co-60	1.19e+2	4.00e-1	1.00e+5	1.00e+1	4.00e-1	2.98e-10	1.19e-3	1.19e+1	2.98e-7
Mn-54	7.86e+2	1.00e+0	1.00e+6	1.00e+1	1.00e+0	7.86e-10	7.86e-4	7.86e+1	7.86e-7
Na-22	5.25e+4	5.00e-1	1.00e+6	1.00e+1	5.00e-1	1.05e-7	5.25e-2	5.25e+3	1.05e-4
Sc-46	2.24e+2	5.00e-1	1.00e+6	1.00e+1	5.00e-1	4.48e-10	2.24e-4	2.24e+1	4.48e-7
Ta-182	3.23e+2	5.00e-1	1.00e+4	1.00e+1	5.00e-1	6.46e-10	3.23e-2	3.23e+1	6.46e-7
Y-88	1.45e+2	4.00e-1	1.00e+6	1.00e+1	4.00e-1	3.63e-10	1.45e-4	1.45e+1	3.63e-7
Total: 10	**8.71e+4**					**1.11e-7**	**9.33e-2**	**3.56e+3**	**1.11e-4**



nucleonica

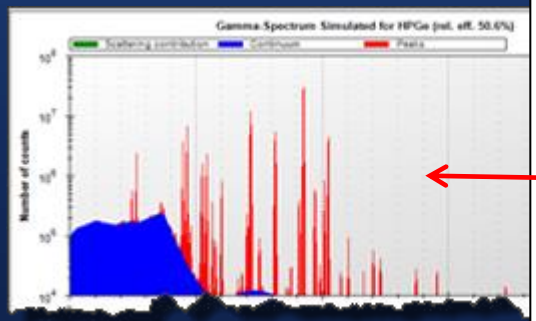
Nuclide Mixtures

Nucleonica's trump card!

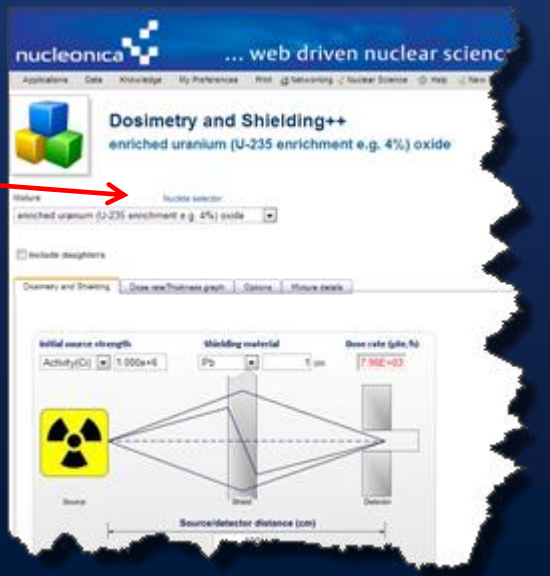
Mass Activity Converter

Decay Engine++

Gamma Spectrum Generator



Dosimetry & Shielding++



e-Ship++

Neutron Activation

nucleonica

Education & Training with Nucleonica

Nucleonica for Smartphones: and Tablet PCs: M-Learning

nucleonica

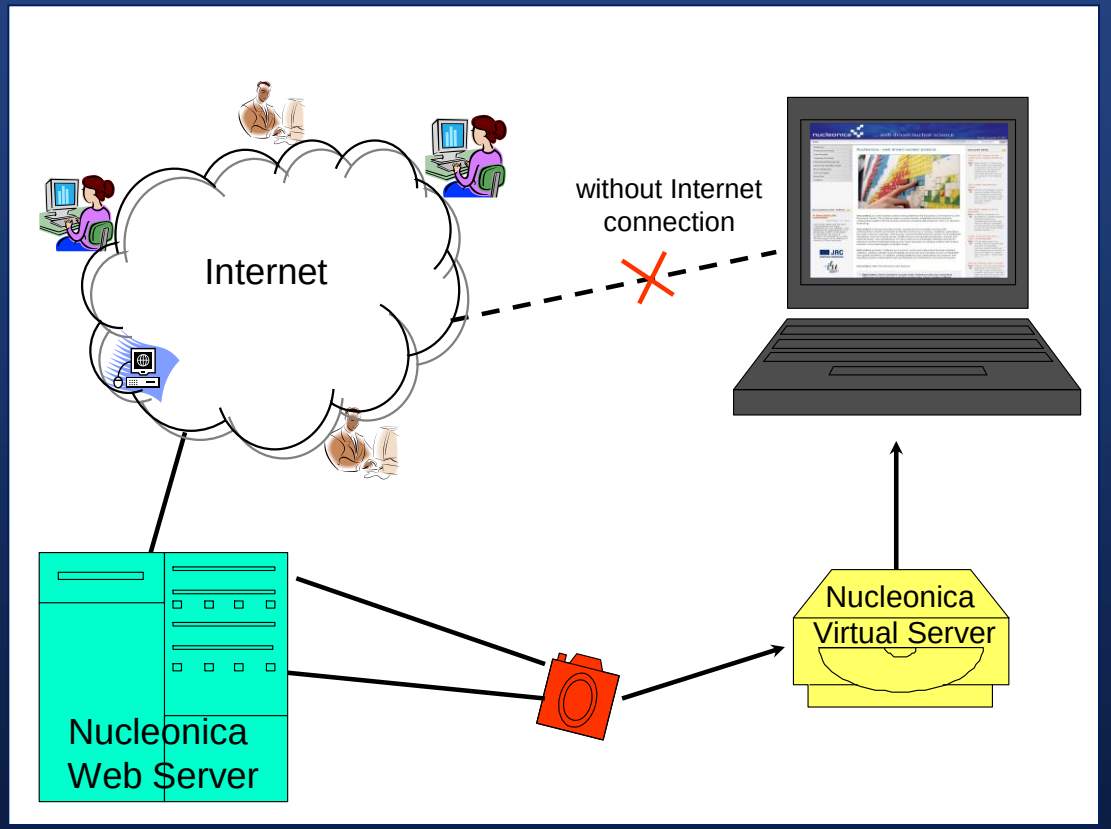
Sneak preview…
(coming soon)

Nucleonica „Apps“
optimised for
mobile devices

nucleonica

Standalone version of Nucleonica

- specially developed for mobile labs and field workers or for use on Notebooks/PCs where an internet connection cannot be guaranteed
- faster than internet version
- allows for more particles in Monte Carlo calculations than the internet version
- allows Monte Carlo dosimetry and shielding calculations (provided you have an MCNP license!)



Education & Training with Nucleonica

Karlsruhe Nuclide Chart

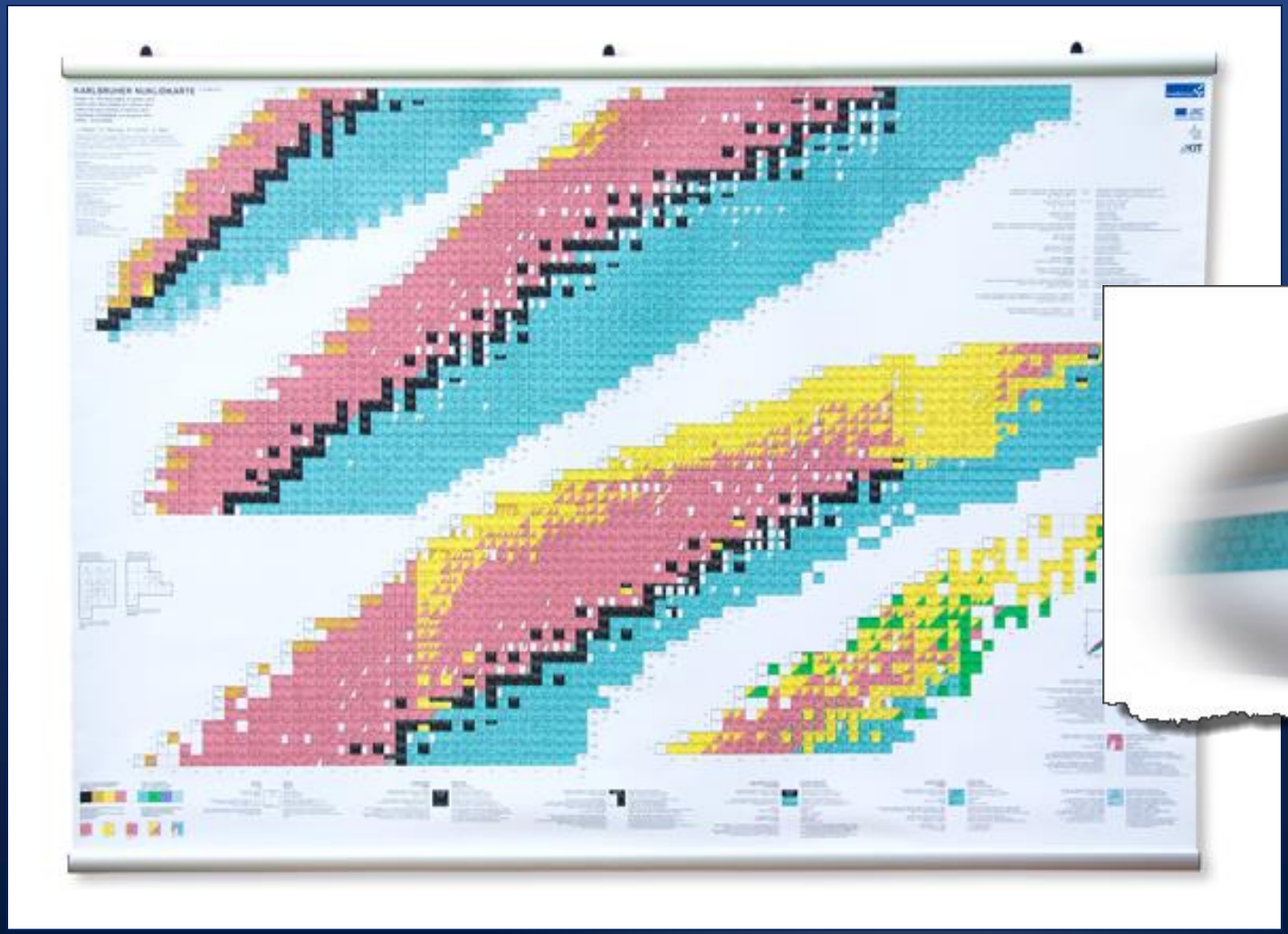
- Fold-out Chart
- Wall-Chart
- Auditorium Chart
- Nuclide Carpet

Nuclide „carpet“
1m x 6.5m

nucleonica

Education & Training with Nucleonica

New Roll Map version of the Karlsruhe Nuclide Chart



with clamping rails and suspension system for easy mounting…

nucleonica

Unique mosaic tiles for the Institute for Transuranium Elements, Karlsruhe

15m x 7m

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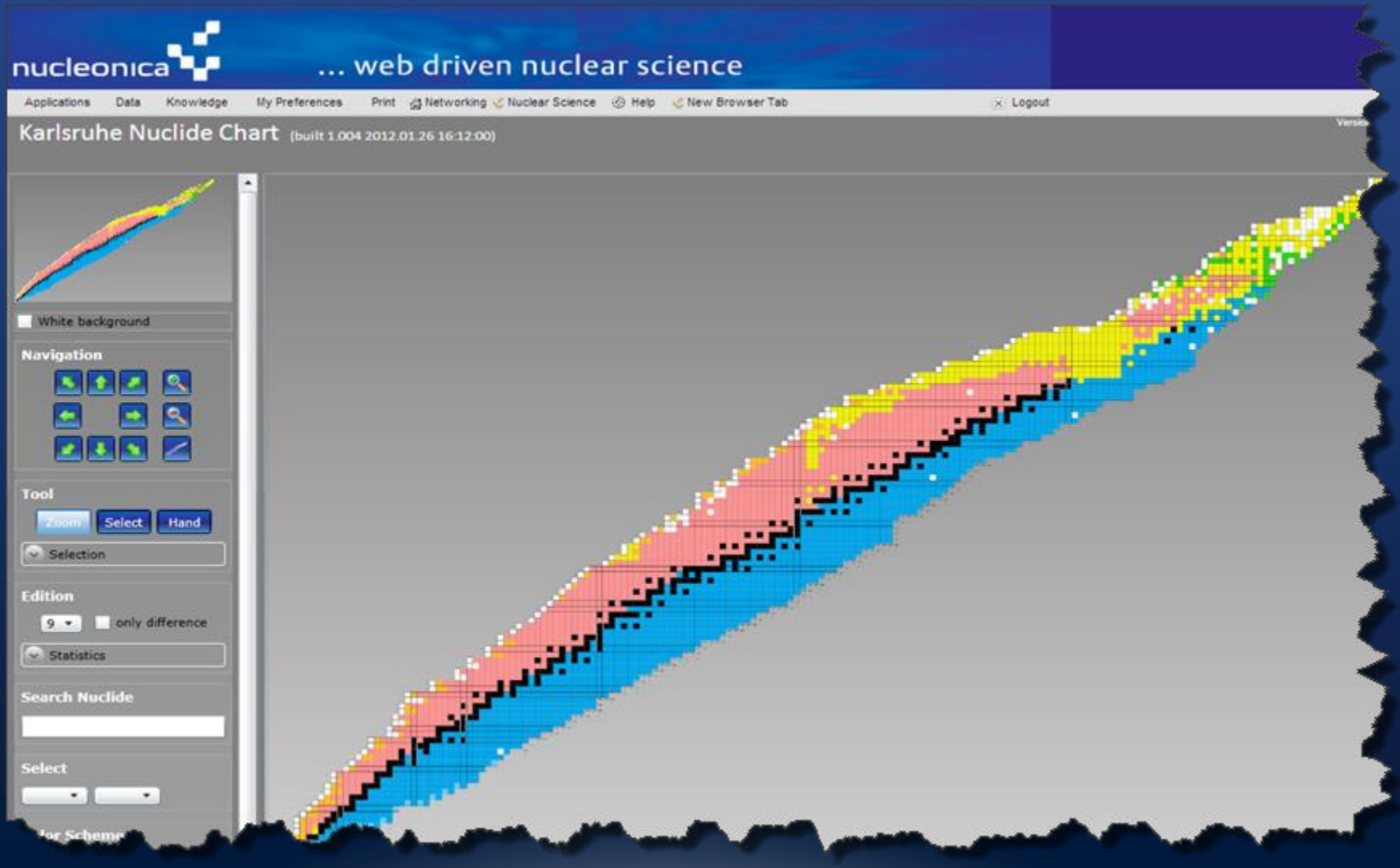
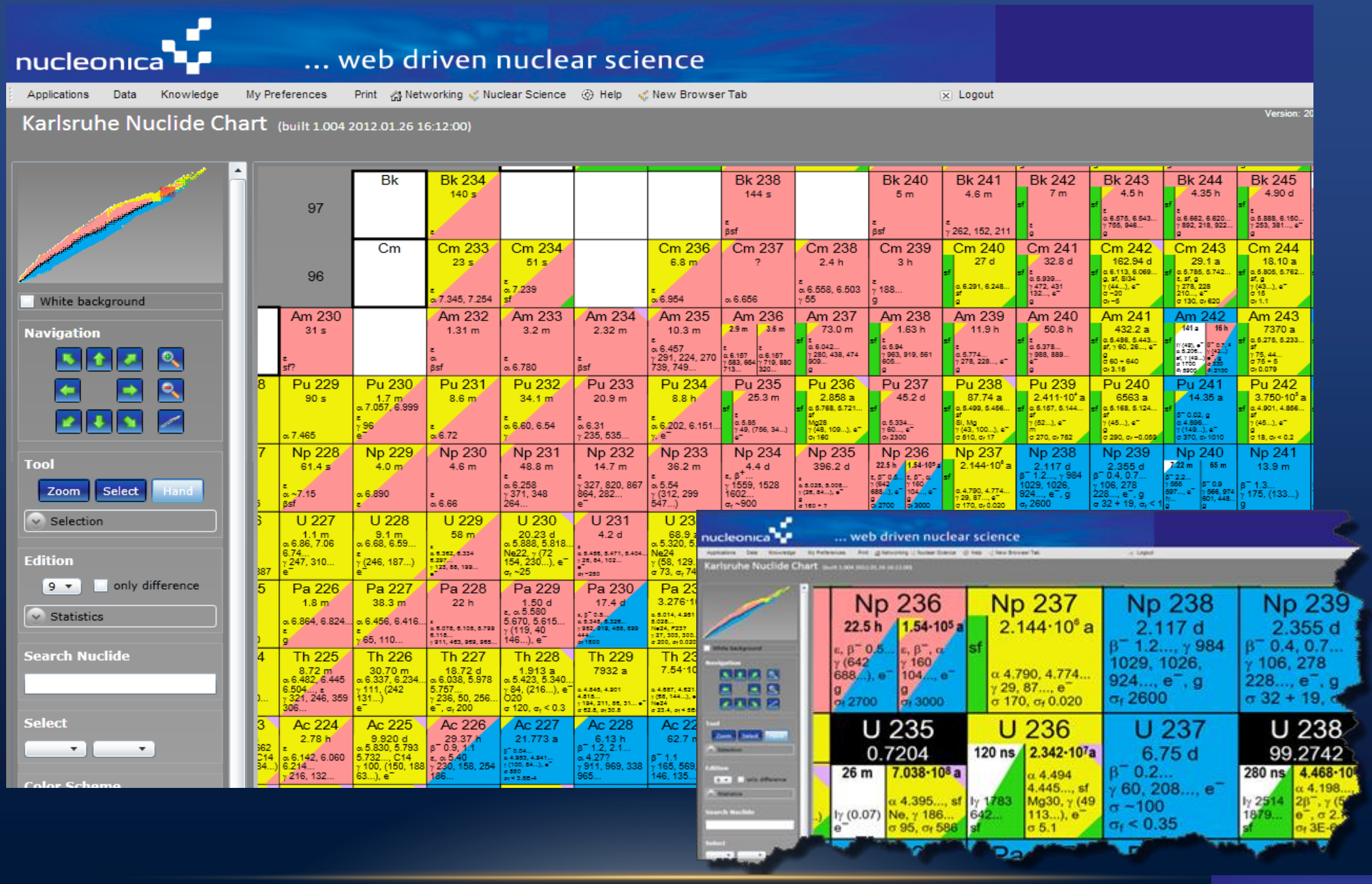
New: Karlsruhe Nuclide Chart Online…




nucleonica
... web driven nuclear science
Applications
Data
Knowledge
My Preferences
Print
Networking
Nuclear Science
Help
New Browser Tab
Logout
Karlsruhe Nuclide Chart
(built 1.004 2012.01.26 16:12:00)
White background
Navigation
Tool
Zoom
Select
Hand
Selection
Edition
only difference
Statistics
Search Nuclide
Select
Color Scheme
Np 236
22.5 h
1.54·10⁵ a
Np 237
2.144·10⁶ a
Np 238
2.117 d
Np 239
2.355 d
U 235
0.7204
U 236
120 ns
2.342·10⁷ a
U 237
6.75 d
U 238
99.2742
26 m
7.038·10⁸ a
280 ns
4.468·10⁹
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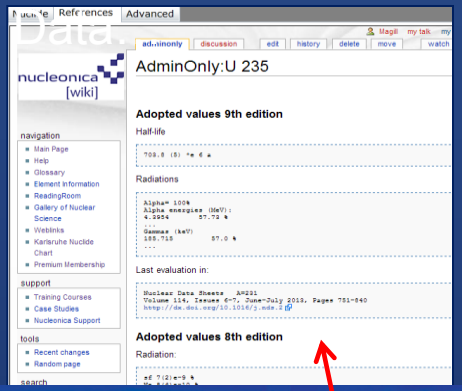
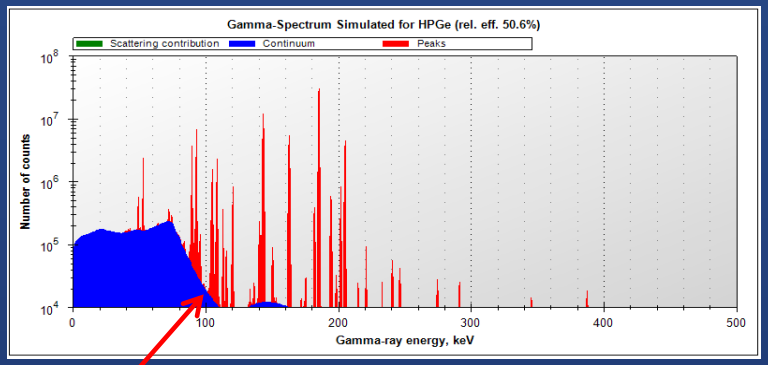
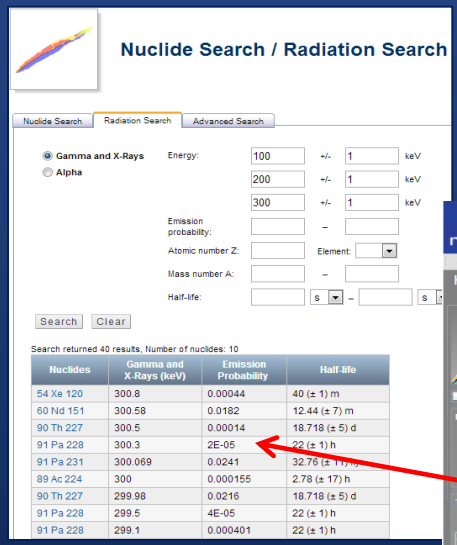
References…

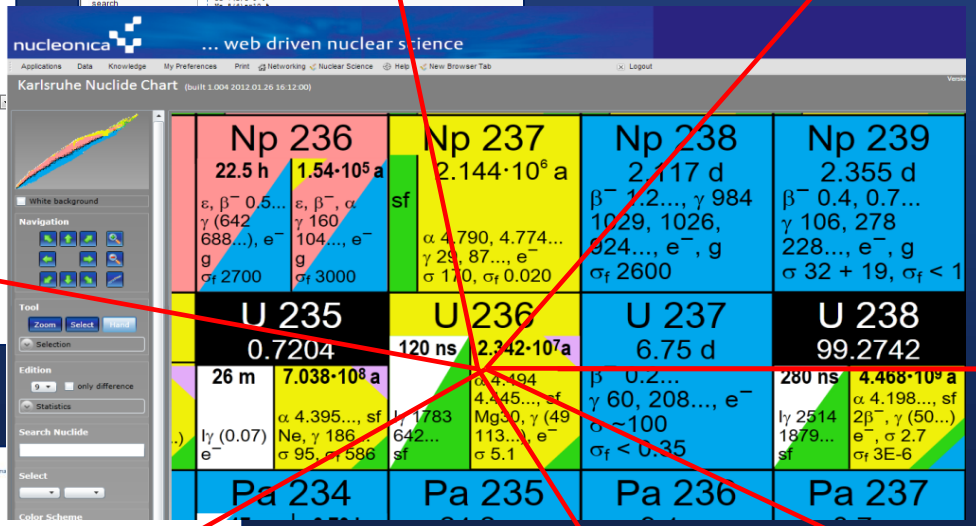


Gamma Spectrum Generator…

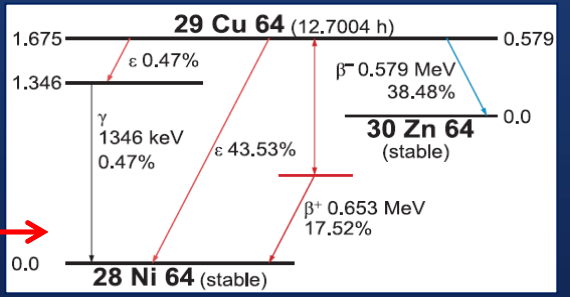


Nuclide / Radiation Search

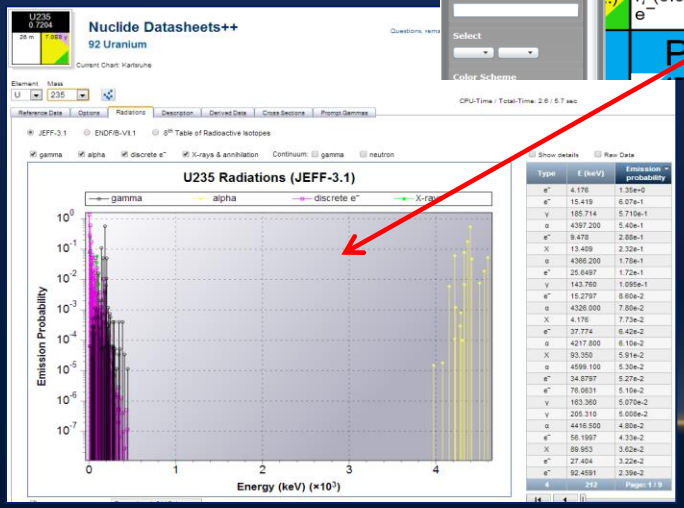




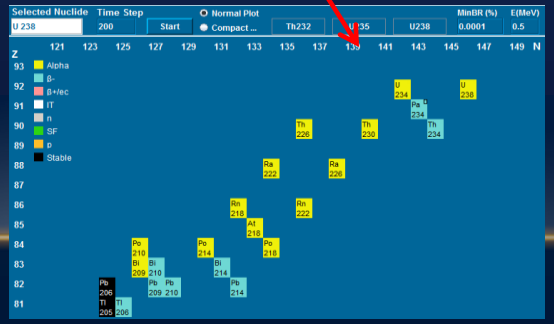
Decay Schemes…



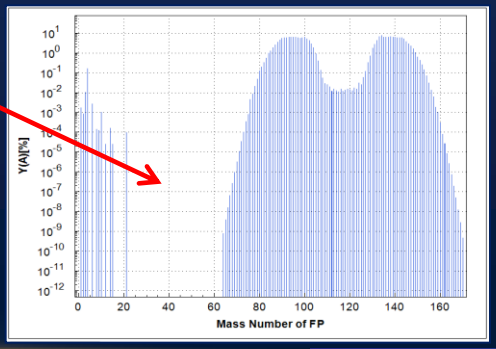
Nuclear Data…



Radioactive Decay…



Fission Yields…



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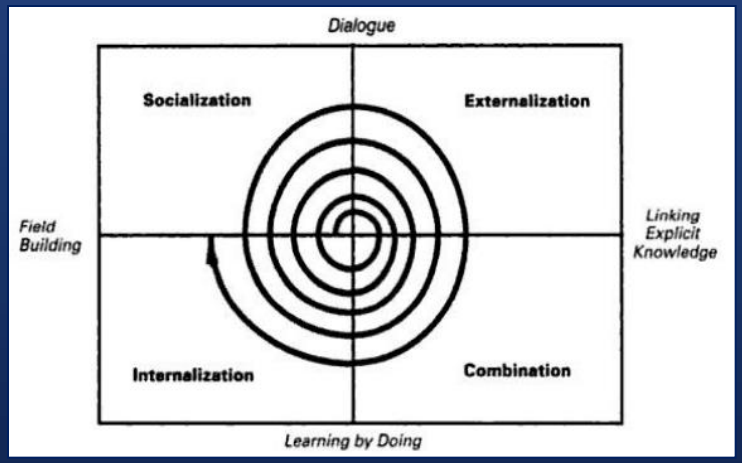
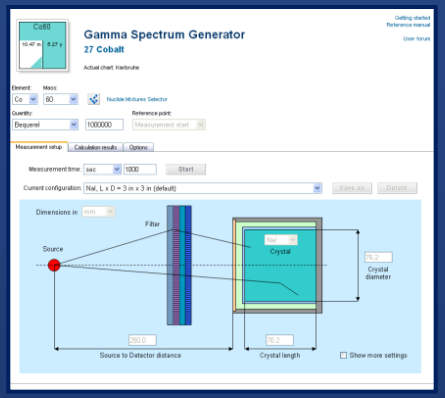
Knowledge Management with Nucleonica

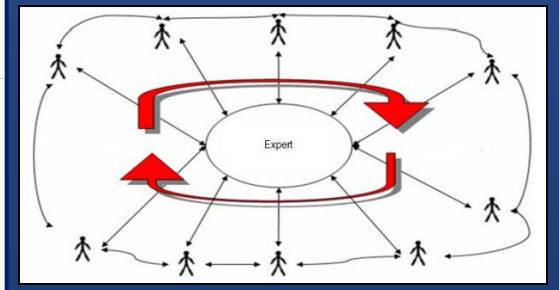
In this slide, the Nucleonica web portal is considered from a knowledge management perspective. Nonaka and Takeuchi have proposed the “knowledge spiral” (shown) in which there are four modes of knowledge conversion: socialization, externalization, combination and internalization (SECI model).



Socialisation: conversion of tacit knowledge to tacit knowledge e.g. an apprentice who works with tutor and learns from observing and imitating the tutor's actions. **Externalization:** conversion of tacit to explicit knowledge. **Combination** is the conversion of explicit to explicit knowledge. The process of systemizing already explicit knowledge into a knowledge system. **Internalization** is the conversion from explicit to tacit, which is closely related to “learning by doing”. At the end of the spiral process, one or more individuals in the organisation have acquired new tacit knowledge.

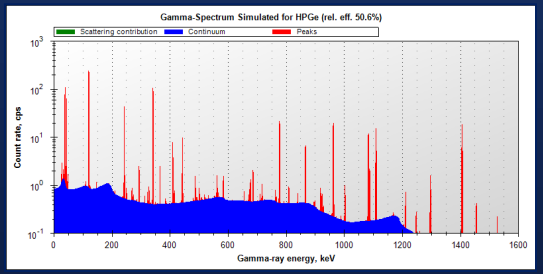


Socialisation: conversion of tacit knowledge to tacit knowledge



Externalization: conversion of tacit to explicit knowledge

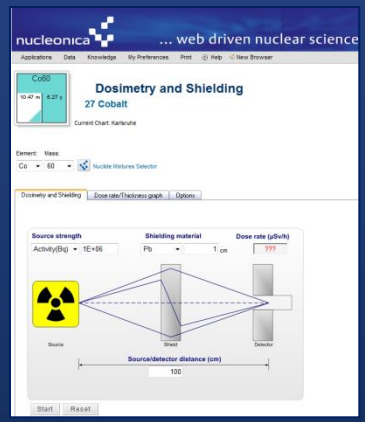
Combination: systemizing explicit knowledge

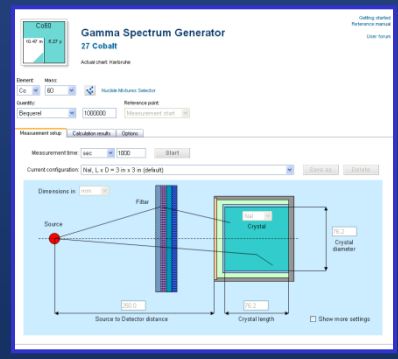


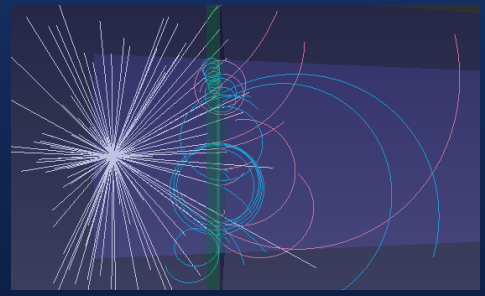
Internalization: conversion from explicit to tacit, triggered through “Learning by Doing”.

Nucleonica: Web-based Software Tools for Simulation and Analysis

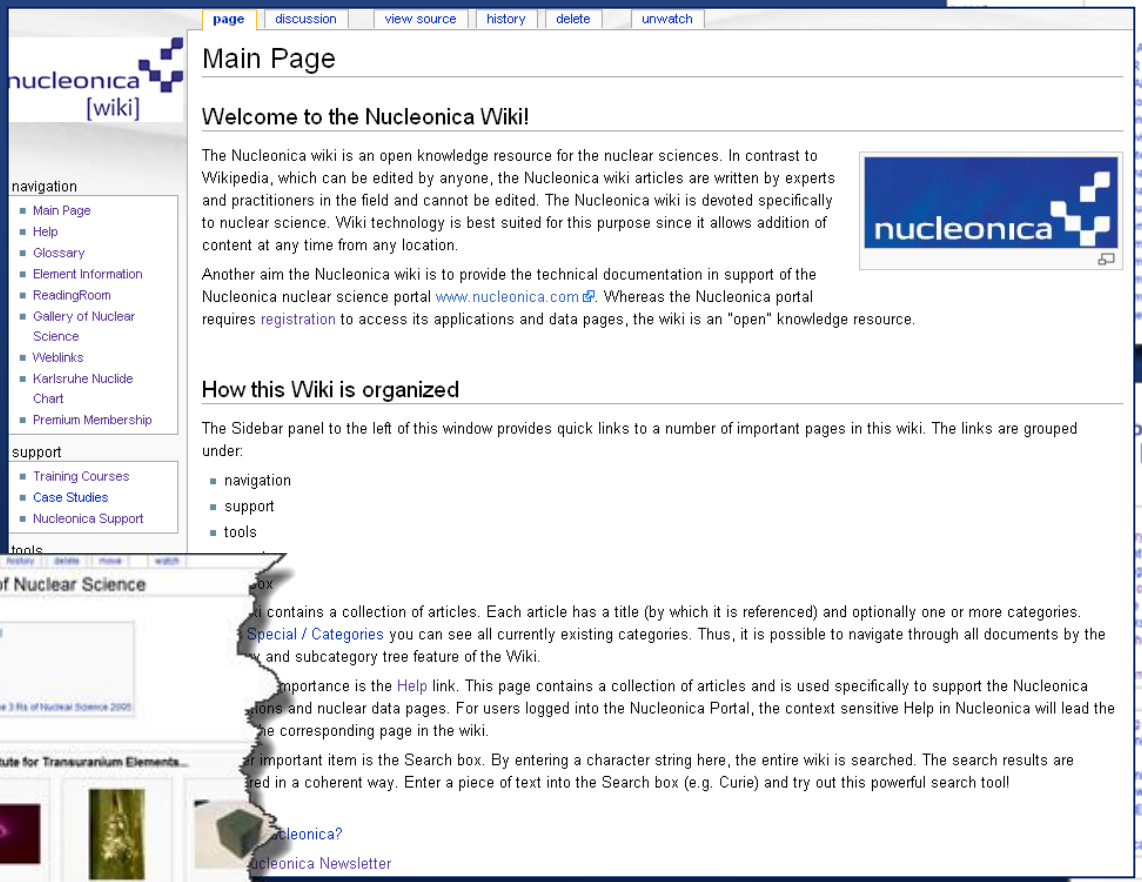
- Nuclear Data Resources in Nucleonica
- Nuclear Science Applications & Tools
  - Decay Engine
  - Dosimetry & Shielding
  - Virtual Cloud Chamber
  - Gamma Spectrum Generator
  - webKORIGEN
  - *e*-Ship
- Education & Training with Nucleonica
  - Nucleonica Mobile
  - Karlsruhe Nuclide Chart
- Knowledge Management with Nucleonica







The Nucleonica Wiki…



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The Nucleonica Blog…

Start of the Name Approval Process for the Element of Atomic Number 114 and 116

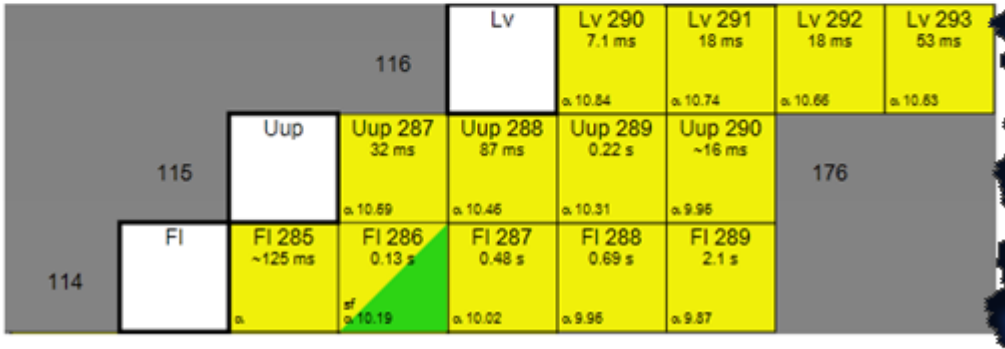
February 19th, 2012

by Joseph Magill

A joint IUPAC/IUPAP Working Party (JWP) has confirmed the discovery of the elements with atomic numbers 114 and 116. In accord with IUPAC procedures, the discoverers proposed names as follows: flerovium and symbol, Fl, for the element with Z = 114 and livermorium with the symbol Lv for the element with Z = 116. The Inorganic Chemistry Division recommended these proposals for acceptance.

Comments should be submitted by 30 April 2012. The text of the Provisional Recommendation can be downloaded from http://media.iupac.org/reports/provisional/abstract11/corish_300412.html.

Comments should be sent to Prof. John Corish at jcorish@tcd.ie.



Extract from the new 8th Edition (2012) of the Karlsruhe Nuclide Chart showing the

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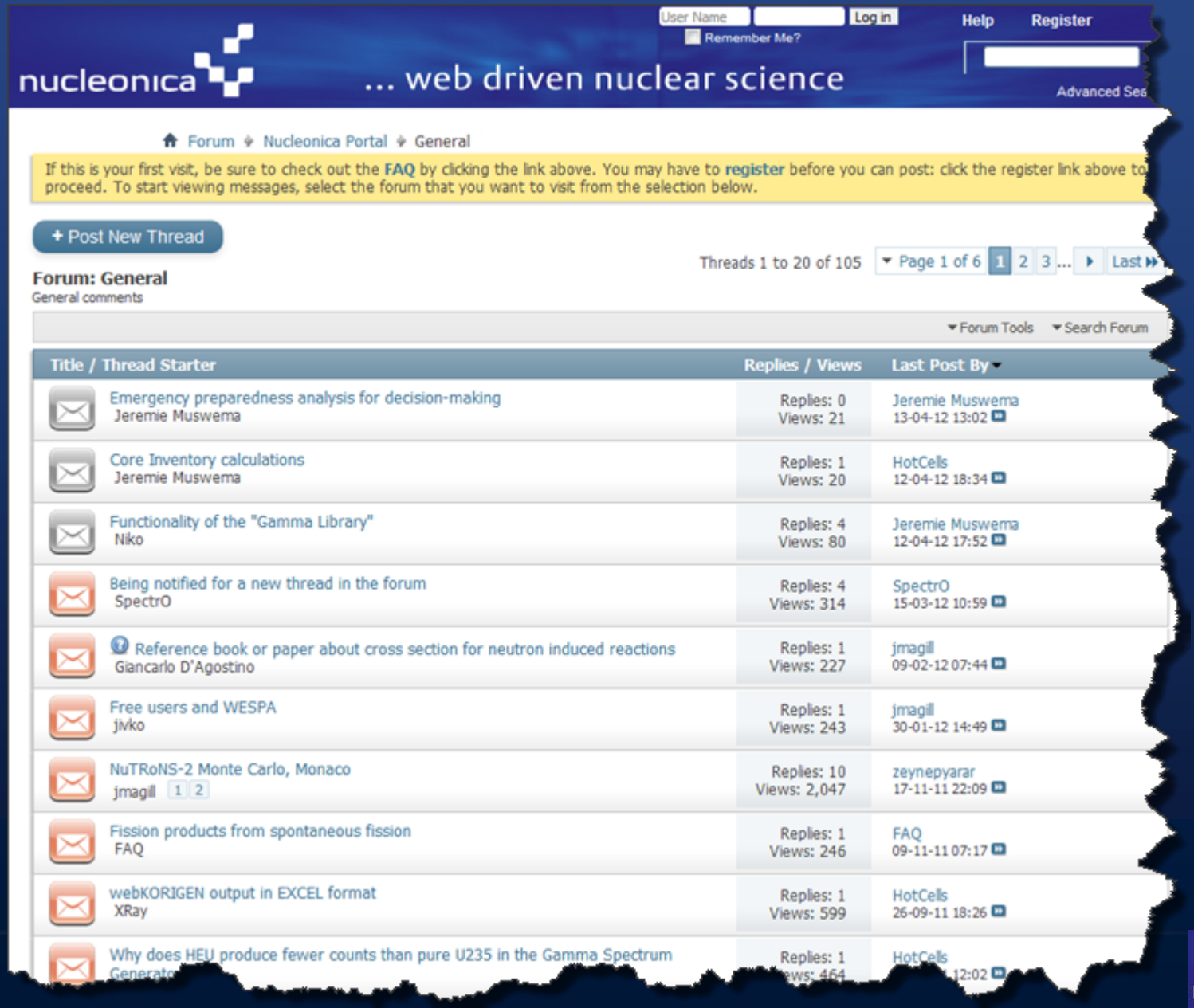
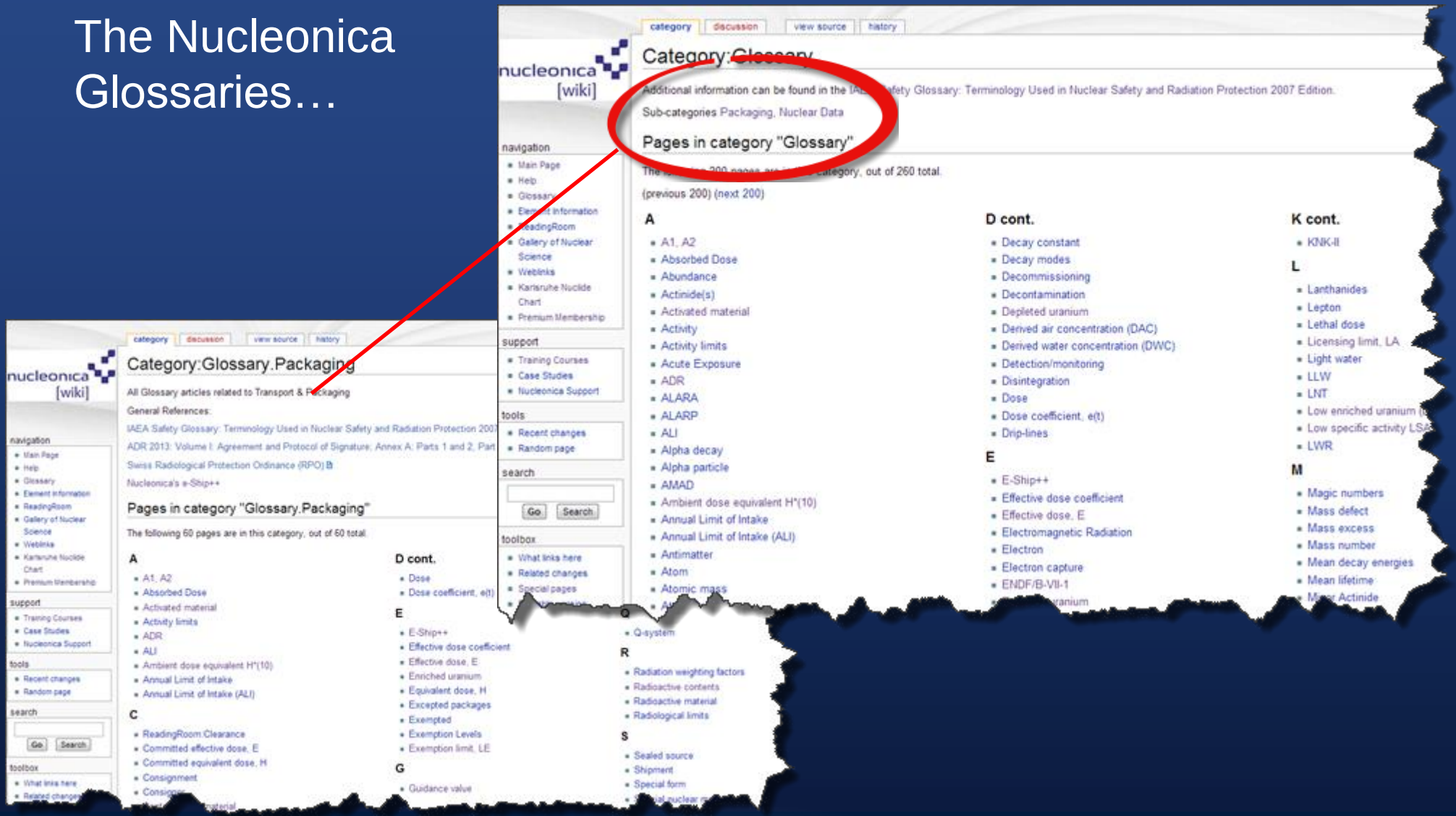
The Nucleonica Forum…

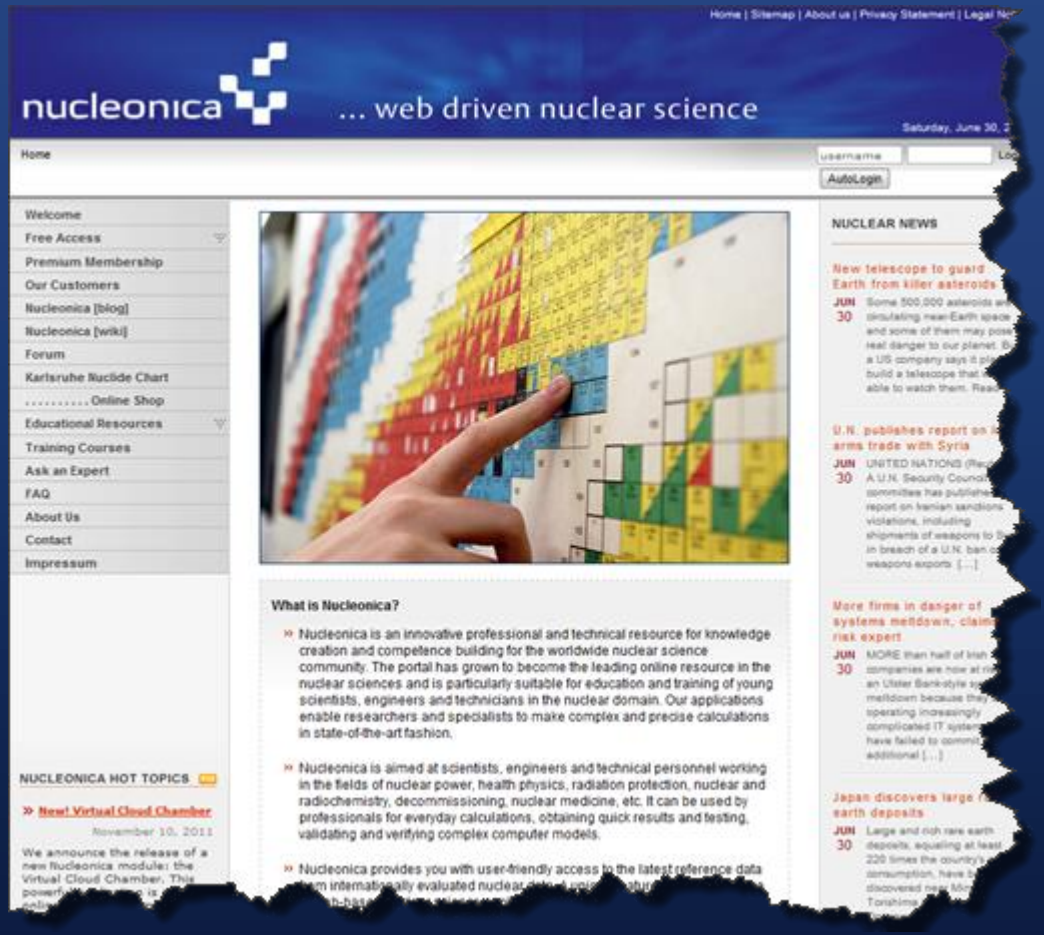


The Nucleonica Glossaries…

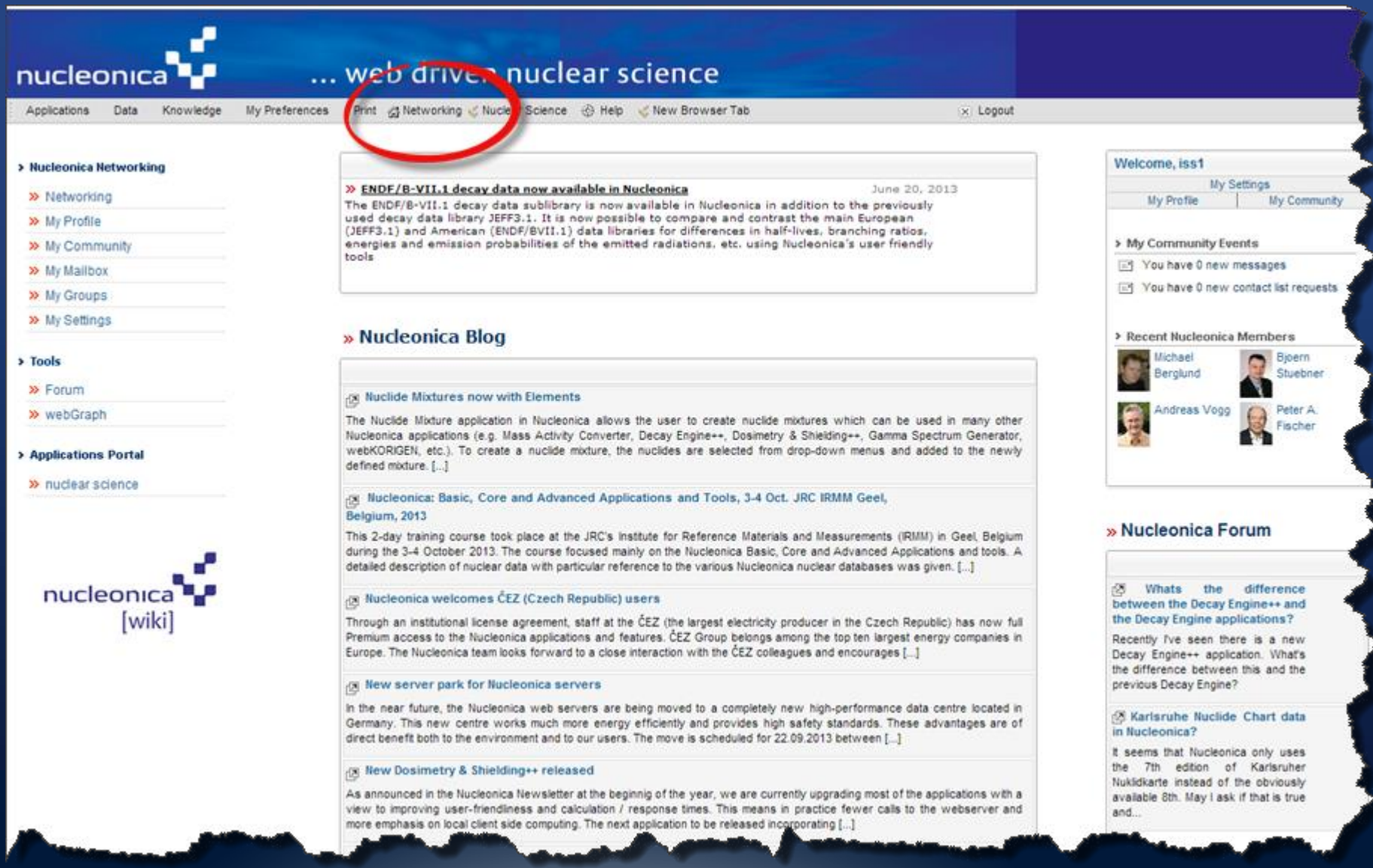


Nucleonica: Tips & Tricks

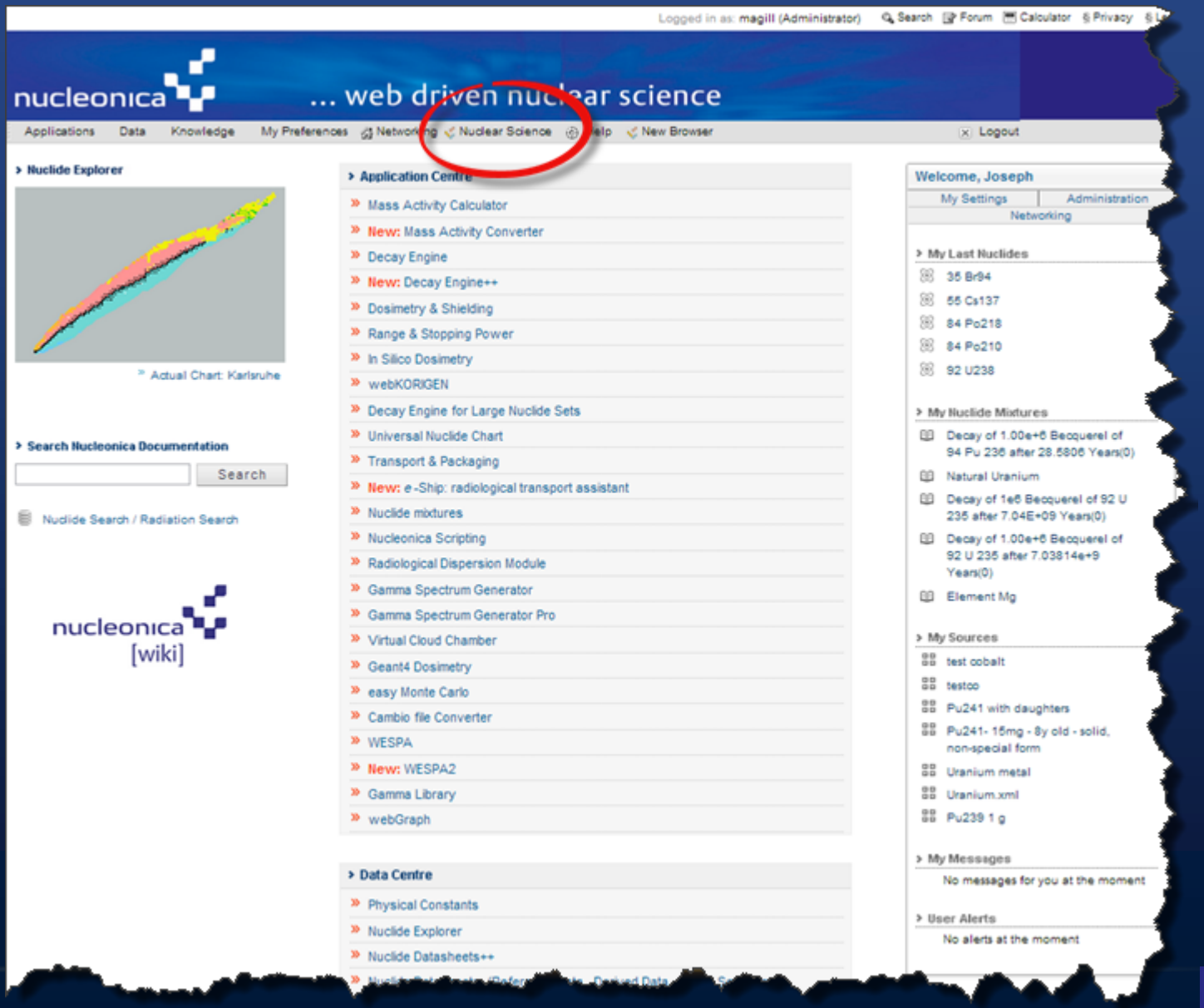
1. Using browser tabs
2. Using the wiki context sensitive Help
3. Accessing the Nucleonica blog
4. Increase font size in your browser
5. Using the datagrid / slider conrol to re-arrange data
6. Increase the default size of graphs in your web browser
7. How to change your login username and password



What you see when you login: Networking page - Wiki, Blog, Forum, …



What you see when you login – Nuclear science page



Thank You!

nucleonica